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THE ELECTRICAL REVIEW

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THE TELEGRAPHIC JOURNAL AND
Electrical Review.
VOL. XVI.—NO. 378.

THE ELECTRIC LIGHT AT COLCHESTER.

As we intimated last week in our "Notes" columns the Colchester installation in its present aspect appears about to expire, principally, it seems, from that most natural enemy of vitality, want of support. Since the recommendations of the Committee of Investigation were published, a letter, signed by Messrs. W. Hewett, junr., and R. Braithwaite, has been circulated amongst the shareholders of the South Eastern Brush Electric Light Company, in which these gentlemen, looking to the interests of the shareholders, advise that the sooner the company is wound up the better for all concerned, as, by stopping any further attempts to carry on the operations of the company, the remaining uncalled capital may be saved.

As this installation was the only one of its kind in England, the eyes of all interested in the development of electric lighting for household purposes were naturally turned upon the operations of the S. E. Company, and the question which will now arise is, what are the circumstances which occasioned such a decisive failure?

In the REVIEW for June 21st, 1884, we expressed grave apprehensions, with our reasons therefor, as to the ultimate success of the installation, and, unfortunately, these have been verified in the short period of eight months. At that time we credited the company with using its capital to good purpose even if the installation came to an untimely end, but whether we were justified in this remains to be seen.

We believe the company has stated that the great obstacle to the development of electric lighting was the Act of 1882; but we do not see how this can be pleaded as an excuse for what has transpired in Colchester, and as it has often been reiterated to the public that the South Eastern Brush Company was the only body working under that Act, the reading of the report of the Investigation Committee must have caused a severe shock to many.

At the opening of the installation on the 11th June, last year, the manager of the company, Mr. Geo. Offor, read the particulars of the cost of plant for 2,200 lamps. That estimate amounted to £10,213, to which an additional item of £1,000 for special discounts allowed S. E. Company was appended. As, according to the Committee's report, only £7,388 has been spent instead of £10,213, we presume that some of the plant has still to be placed in position. The working expenses were estimated at £4,000, and the revenue at ½d. per lamp per hour, for 1,200 hours per annum, with profit on supply of lamps, fittings, &c., was calculated to reach the respectable total of £5,650. After deducting the working expenses the enthusiastic Mr. Offor, amidst applause, announced that there would still be left sufficient profit on which to declare a dividend of 14½ per cent.

It must not, of course, be forgotten that these estimates were based on the assumption that 2,200 lamps were to be in operation, but, as a matter of fact, we doubt whether they ever reached one quarter of that number.

Therefore, the shareholders and the general public will be interested in ascertaining whether the company finds that the light was not taken advantage of with that eagerness which had been expected, or is the price of ½d. per hour for a 20 (?) candle-power lamp too high? Is it that the apparatus was not infallible, or is that when operations were commenced in the autumn of 1882 the directors had no definite idea of what they were about to do? Had any estimates been laid before them, *previous* to the commencement of the installation, of the probable cost, working expenses, and revenue, and if so were any steps taken to verify such calculations? We trust that the directors will answer the queries relative to the B. T. K. system, and at the same time furnish us with a copy of the report of Prof. George Forbes thereon, for it must be in the memory of many that in a circular addressed to the shareholders, and dated March 8th, 1884, the directors stated that Prof. Forbes "is now engaged in making such examination." It may be possible that the report has not yet been received, if so, we do not think we shall be overstepping our province by asking the reason why? We trust that a full explanation of the collapse at Colchester will be at once forthcoming, for such a disaster cannot fail to have a demoralising influence upon the prospects of central station and house lighting in the country, especially if it be shown that the apparatus was in fault and not the management.

We have yet hopes that the installation may be revived, for if a company like the parent "Brush," or a firm such as that of Messrs. Crompton & Co., could be induced to handle the matter energetically we see no reason, customers being forthcoming, why Colchester should not yet be the first town in England to be electrically lighted, if not throughout, at all events in its principal thoroughfares, and at a fair profit to the suppliers of electrical energy. Would not this be an excellent opportunity for a fair trial of the Gaulard and Gibbs transformers?

ELECTRIC LIGHTING UNDERGROUND.

IN our excellent transatlantic contemporary the *Electrical World* Mr. C. E. Reynolds gives the results of his experience in lighting tunnels by means of incandescent lamps. He goes on to say:—

But very little has been done with regard to electric lighting underground and the great advantage it has in mining, tunneling, &c., over the ordinary lamps in common use.

We are continually hearing of accidents in coal mines, owing entirely to the carelessness of some miner who opens his lamp to light his pipe or strike a match for the same purpose. This ought to be and is preventable. If miners were supplied with lamps which they could not open, most of the accidents, and in fact nearly all, would be prevented.

Now an incandescent lamp cannot be opened, as every one knows, without breaking it. Why should not a lamp of this form take the place of the Davy lamp? The advantages are immense—1st, very much more light; 2nd, no danger to be feared from a man opening his lamp; 3rd, cheapness. These points of merit have been well illustrated in the construction of a tunnel about one mile long in Brazil, through the Mantiqueira Mountains.

I lighted the tunnel with the Swan incandescent lamp, and thus facilitated the working of the tunnel to such a degree that the extra expense of the electric lighting was more than counterbalanced by the great saving of time due to the extra lighting power.

I used the Brotherhood engine and Maxim dynamo attached on one shaft. The machine was placed at one mouth of the tunnel—at the north heading—one circuit being carried straight into the tunnel from the dynamo and the other being carried over the top of the mountain into the south heading, as shown in fig. 1. On account of the extra resistance of the long line over the mountain, I placed hoop-iron resistance between the dynamo and the line on the short circuit to equalise the currents. The wires over the mountain were carried on poles and attached to ordinary porcelain insulators. They were bare six-strand copper wires, and the main lead on entering the tunnel was covered with a thick coating of India rubber and tape, the return wire being left bare.

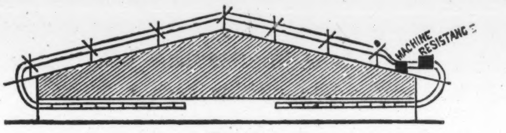


FIG. 1

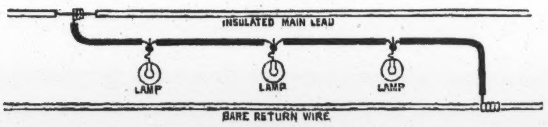


FIG. 2.

The lamps were arranged in groups of three in series, as shown in fig. 2, and each lamp had a spiral brass spring attached to the top to keep it from being broken by any great shock. I tried several ways of arranging the lamps, but the result was never so good as when they were grouped in threes. Whenever one of the three was broken, it only affected the group of which it was a member. No change was perceptible in any of the other groups.

The greatest current used to run these lamps was 1·34 ampères per group of three lamps, and 13·4 ampères per circuit of 30 lamps. Thus the current was strong enough to give a splendid illumination, and at the same time it was perfectly safe to handle, the electromotive force being low.

One of the difficulties experienced at first was to get the miners (mostly Italians) to work by the light of the Swan lamp instead of by the ordinary oil lamp. They were afraid of it; but this was a difficulty soon overcome.

The wires were fixed against the sides of the tunnel by wooden plugs driven into holes bored for them. At first these were simply laid along the tunnel without any covering, but I soon found that it would never do to leave them bare. The pieces of rock flying about from the frequent blasting soon made havoc both with the wires and with the lamps. Some means had to be devised to protect them. In the case of the wires it was easy enough, but with regard to the lamps it was more difficult, as they had to be arranged so that any miner who was going to blast could take them down and stow them away in a safe receptacle himself, as, of course, I could not be in every place at once, and we had no one else who understood anything about it.

The wires I placed in a casing of thick boards right through the tunnel, with a lid that could be easily opened when I wanted to get at the wires.

For the lamps, I bored holes in the roof of the tunnel and inserted a wooden plug, and in that fastened an iron hook. With this arrangement a miner (as soon as everything was ready to fire the blast) unhooked every lamp in his vicinity, and then he stowed them away in a thick wooden box constructed for the purpose and securely fixed against the side of the tunnel. The connections to the lamps from the main leads were spiral insulated wire, so that there was no danger of the wires breaking from being constantly moved. Six lamps were placed on each machine drill at the two headings. These were arranged with plenty of slack wire, so that the miner could place the light in any position he liked and wherever he wanted it. The great advantage of these lights was shown in this part of the tunnel more than at any other part, as the drills used in boring the holes had to be constantly watched, and the ordinary oil lamps were being incessantly trimmed and fresh oil put in. Even then, with oil lamps, it was extremely difficult to see to work properly, whereas in using the electric lamp the miner could attach it to his cap and it never required attending to. In whatever direction he looked, the ray of the lamp was thrown on the same spot.

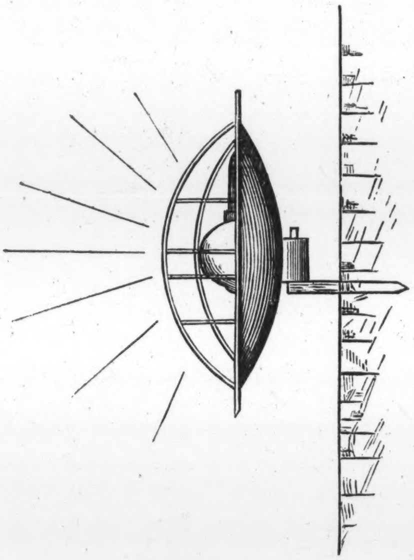


FIG. 3.

When all the holes were drilled and ready for blasting, the machine drills, attached to an iron carriage, were brought about 100 yards away from the heading, together with all the lamps fixed to them.

I have mentioned that the lamps were fixed to the roof. Most of them were arranged in this way, but some also were fixed to the sides of the tunnel as shown in fig. 3. These could also be detached, if necessary, and placed in a box during blasting.

Every lamp was shielded with a wire frame for further safety, fig. 3. The whole of these lights worked well from beginning to end, and without a doubt this means of lighting a tunnel during construction will be more fully appreciated the more it is used.

TRAIN LIGHTING BY ELECTRICITY.

"Inquirer" writes to *Engineering* as follows:—"In Mr. Crompton's letter of December 26th last, the first cost and maintenance of the 'dynamo accumulator system' are said to be 'quite double' that of 'direct running,' and it would be interesting to learn what foundation there may be for such a statement when Mr. Crompton himself says 'there is absolutely no comparison between' the two systems. It would also be interesting to know whether 'there is absolutely no comparison between' the Tower and the Willans engines, seeing that in the 'Journal of the Society of Telegraph Engineers and Electricians,' vol. xiii., page 217, Mr. Crompton is reported, on March 13th, 1884, to have spoken as follows:—'I happen to have had a good deal of experience in the use of the Willans engine that he used for this experiment, and I think that perhaps Mr. Massey has not dwelt sufficiently on the fact that a great portion of the praise, which must be given to all concerned in the Metropolitan Railway experiment, must be given to Mr. Willans himself, who has shown great ingenuity in putting together the apparatus required for those experiments. His engine, taken by itself, is one of the most beautiful pieces of steam machinery that is in use at the present day. Although it is very simple in construction and the number of moving parts is exceedingly small, it gives a very high economical result. I believe I may say without fear of contradiction that it is the only high-speed engine that has given results at all approaching the economy of large engines; and as it can run at a sufficiently high speed to be coupled direct to the dynamo, and thus do away with all belting and gearing, it gives us the simplest combination of engine and dynamo that we can have at present. Mr. Massey's figures show that even the very small engine placed on the train used only 30 lb. of water per indicated horse-power per hour, which is a very high efficiency for so small an engine, and I have every reason to believe that Mr. Willans has obtained even greater economy from his larger engines. As regards the durability of these engines, I have had one in use driving my saw mill for three or four years, and it has worked continuously without showing any of the defects common to high-speed engines. The cost of repairs has been very small, in fact rather less than that of ordinary horizontal steam engines giving the same power for the same time."

Messrs. Heenan and Froude say:—"With regard to the question raised about how the item of coal consumption is to be charged to the lighting on the Great Eastern Railway, inasmuch as locomotives, spherical engines, and dynamos are the property of the Great Eastern Railway, and the experiment is being tried by the company for their own information, we must leave it to them to make their own tests in their own way, and they will take their own view whether it is a question of science or commerce. The present correspondence is not the place in which to make statements of the results of our tests, the subject matter being the practicability or non-practicability of train lighting by electricity by any of the systems so far tried, and suggestions for improvement."

Mr. W. Langdon writes:—"I have contended, and still contend, that unless its application provides for the illumination of coaches when detached, electricity will not secure a fair footing as an illuminant for this special purpose. In expressing this opinion I am giving expression to my own views only, and have no authority whatever to represent the opinions of others. Would railway companies feel justified in subjecting their passengers, or any portion of them, to darkness at any known point upon their system? That a lamp may go out; that a train may be late, and have to complete its journey in semi-darkness; that a train may enter a dense fog, and subject the passengers to a like result, are all casualties which cannot be foreseen, and which, for this reason, occupy a very different and distinct position from that which entails darkness at a given point for a given period. In like manner there is a great difference in such a case when they change the lamps. It is usual when a lamp burns dim, and requires changing, for the man who removes it to replace it by another at the same time. The public seek a light by which they can read. It is not that they have no light at all, but that they wish for a better light. The question is one of considerable magnitude, and in my humble opinion it is wrong to expect that railway companies will regard with favour any system which does not thoroughly provide for the exigencies of that company's service."

Referring to Messrs. Massey and Willans' letters, which we have already published, and "Inquirer's" letter given above, Mr. Crompton says:—"I think it is a great pity that Messrs. Heenan and Froude on the one side, and Mr. Willans on the other, should have led the correspondence to a side issue on the comparative merits of their respective engines. Both engines have given remarkably good results, and have been a principal means of rendering this form of train lighting a commercial success; no doubt each of them have special points in which they excel, but the main thing for the public to know is that there is more than one compact, well-designed, and economical high-speed engine fitted for this service. I thank 'Inquirer' for quoting at length my remarks at the meeting of the Telegraph Engineers on the excellence of the Willans engines. These remarks I now hardly endorse, but I cannot see his object in making the quotation. I have unfortunately not got my letter of December 26th now before me, but I certainly do not recollect ever writing the words 'there is absolutely no comparison between the Tower and the Willans engines." As to 'Inquirer's" request, that I should prove by figures my statement that the first cost and maintenance of the van-dynamo-accumulator-system is double that of direct running, I would rather not make this correspondence the means of advertising rival prices; but in order to give your readers themselves a fair chance of forming their own opinion on this point, it is only necessary for them to see that if we set aside the cost of the leads, branch wires, connections, and lamps, which are common to both systems, that the seat of the van dynamo, the gear for driving it from the van axle, and the complex electrical controlling apparatus necessary, will of itself balance the cost of the steam dynamo, which forms the whole of the generating plant required by the direct system; this leaves the first cost and maintenance of the van dynamo system to exceed that of the direct system by the first cost and maintenance of the accumulators themselves; whether or not this first cost and maintenance added on to that of the van dynamo will not cause it to reach double that of the steam dynamo alone, I leave to the judgment of those of your readers who had extended experience in the manufacture, fixing and up-keep of accumulators. Mr. Willans has called attention to several discrepances on the published dimensions of the steam dynamos used in the Great Eastern Railway locomotives. These are easily explained. Not only have the dimensions been slightly varied from the pattern first put down, but in one case the full dimensions have been given outside the casing, instead of over the overhanging parts. Mr. Langdon, in his last letter, says, 'the public seek a light by which they can read.' This is the exact truth, and we are obliged to Mr. Langdon for putting it so neatly, but with all respect for his opinion that the railway companies ought to withhold this boon until they can get a system which will not only light the train for ninety-five per cent. of the time that the passengers are in the carriages, but will also insure that they are also lighted up for a considerable period before the train starts, and whilst standing at the few stations where engines are detached, and that will insure the same perfect lighting on all slipped carriages, detached portions of the train, and on small branch lines. I think, Sir, that railway companies have not usually followed this course. Most of their great improvements have been introduced gradually, and I contend that Mr. Massey's experiments on the District Railway, those made by Mr. Webb on the London and North-Western, and lastly, the very complete experiments going on on the Great Eastern Railway. and now under discussion, have proved that we can by the direct system give a light by which the public *can* read, that the interruptions of the light will be few and insignificant, that by this system the cost is small, and likely to be less than the cost of lighting by oil or gas, and that this advantage of the small cost of the direct system is likely to be lost if the railway companies insist upon the additional complication of accumulators. The complications, electrical and mechanical, caused by running dynamos and accumulators in parallel circuit to feed a system of lamps, are very interesting to specialists, but would take up far too much of your valuable space for me to enter on the question at the present time."

Mr. Massey further writes :—" When I suggested that Mr. Langdon might fairly be said to represent a class of individuals whose parrot-like cry he was consciously or unconsciously repeating, I used an ordinary phrase which was not intended to convey the impression that the person alluded to spoke with any sort of authority ; and as Mr. Langdon may now be said to represent neither the railway people nor the passengers, I shall be quite content to leave your readers to decide whether my flippancy or his superciliousness is the more likely to 'at all advance the object in view.' Not having as yet attained to the proud position of a superintendent of railway telegraphs, I have not constituted myself 'arbiter-in-chief ;' but I am anxious that the truth about this train lighting business should be known, and, if anything I say will act as a corrective to that dignified stupidity which occasionally prevents a judgment based on facts being distinguished from the mere expression of an opinion, I shall always have pleasure in crossing quills with Mr. Langdon on any subject except that of primary batteries and signals. It is indeed kind of you, Sir, to give up so much of your valuable space to the present discussion, and I trust that through your help electric lighting when applied to railway trains will not suffer as it has done in other cases on account of the many misleading statements made with regard to the comparative cost of it and of gas lighting. Compressed oil gas of a very high illuminating power can be supplied for something like 12s. per 1,000 lamp-hours, and it is only by using economical engines to drive the electrical machinery that a better light can be provided at rather less expense, as anyone who cares to go thoroughly into the matter may see for himself. Supposing that a train can be fitted out completely with 50 lamps and suitable machinery on the locomotive for £170, the following figures will show all the maintenance charges :—

	s.	d.
Coal and water per 1,000 lamp-hours ...	4	0
Lamp renewals, oil, and waste per 1,000 lamp-hours	4	0
Interest, depreciation, &c., per 1,000 lamp-hours	3	6

that is, nearly the same price as gas of half the candle-power per light. But if, as on the Great Eastern Railway, more than 30 lbs. of steam are taken from the locomotive boiler per indicated horse-power per hour, and if the first cost of the installation is more than I have stated, the money paid for the electric light would probably be some 5s. more per 1,000 lamp-hours than is usually paid for compressed gas of the highest quality. The coal consumption could not then be less than 1 lb. per mile on the coal bill of an express engine, while for local traffic it would be from 4 lbs. to 6 lbs. per mile, or just twice as much as it need be ! If the railway officials know this, well and good."

Fall of a Chimney in the General Post Office, Glasgow.—On Saturday afternoon, 7th inst., about 2 o'clock, a large chimney, to which a number of wires had been attached by the company who have lately contracted to supply the Post Office with the electric light, collapsed, without warning. Wires were in process of being led into the building from Millar Street, and, indeed, some had been added on that morning. The wires are much thicker and heavier than the usual telegraph wires, and as the strain was very severe, and apparently no, or not sufficient, counter-balancing strain had been provided, the chimney came down, crushing through the roof on to the stairs which lead into the telegraph room. Fortunately no person was injured, though a good deal of damage was done to the roof.

MATHER AND PLATT'S NEW DYNAMO.

MESSRS. MATHER & PLATT have for some time past, as our readers are well aware, given great attention to the improved construction of dynamo-electric machines of the Edison and Edison-Hopkinson type. The armatures of these machines, we need scarcely repeat, are wound in a similar manner to the plan adopted by Siemens, *i.e.*, the coils are not threaded through the iron ring, as is the case with the Gramme, but are wound over the external surface of the drum only.

Messrs. Mather & Platt have recently designed and constructed a dynamo of their own, in which, however, they have adopted the Gramme system of winding the armature. These gentlemen are evidently not impressed with the views of those who hold that the internal winding of ring armatures adds only so much useless resistance to be overcome, and we have but little doubt that they will, with experience in their new venture, turn out machines of the highest efficiency. The new machine, three views of which are shown, may be described as a modification of the original Gramme type, carried out on the same principle as Dr. John Hopkinson's reconstruction of the Edison dynamo. The mass of iron in the magnets and core of the armature is very largely increased, and the length of the magnetic circuit is shortened. The machine has a double magnetic circuit, which, though slightly diminishing the efficiency of the machine, greatly increases its compactness and symmetry of form.

The shafts of the magnets are made of wrought iron, and let into cast iron pole pieces, which have an increased section proportional to the lower magnetic permeability of cast iron over wrought iron. The lower pole piece is extended to form the bed of the machine, thus securing great compactness, and keeping the centre of gravity of the moving parts as low as possible.

The armature of the machine has a free space left along the shaft to secure internal ventilation, and the commutators are large compared with the general dimensions, in order to diminish the sparking by giving as large a surface of contact as possible between the brushes and commutator bars. The commutators of all the machines have 40 bars of toughened brass, and are insulated with mica.

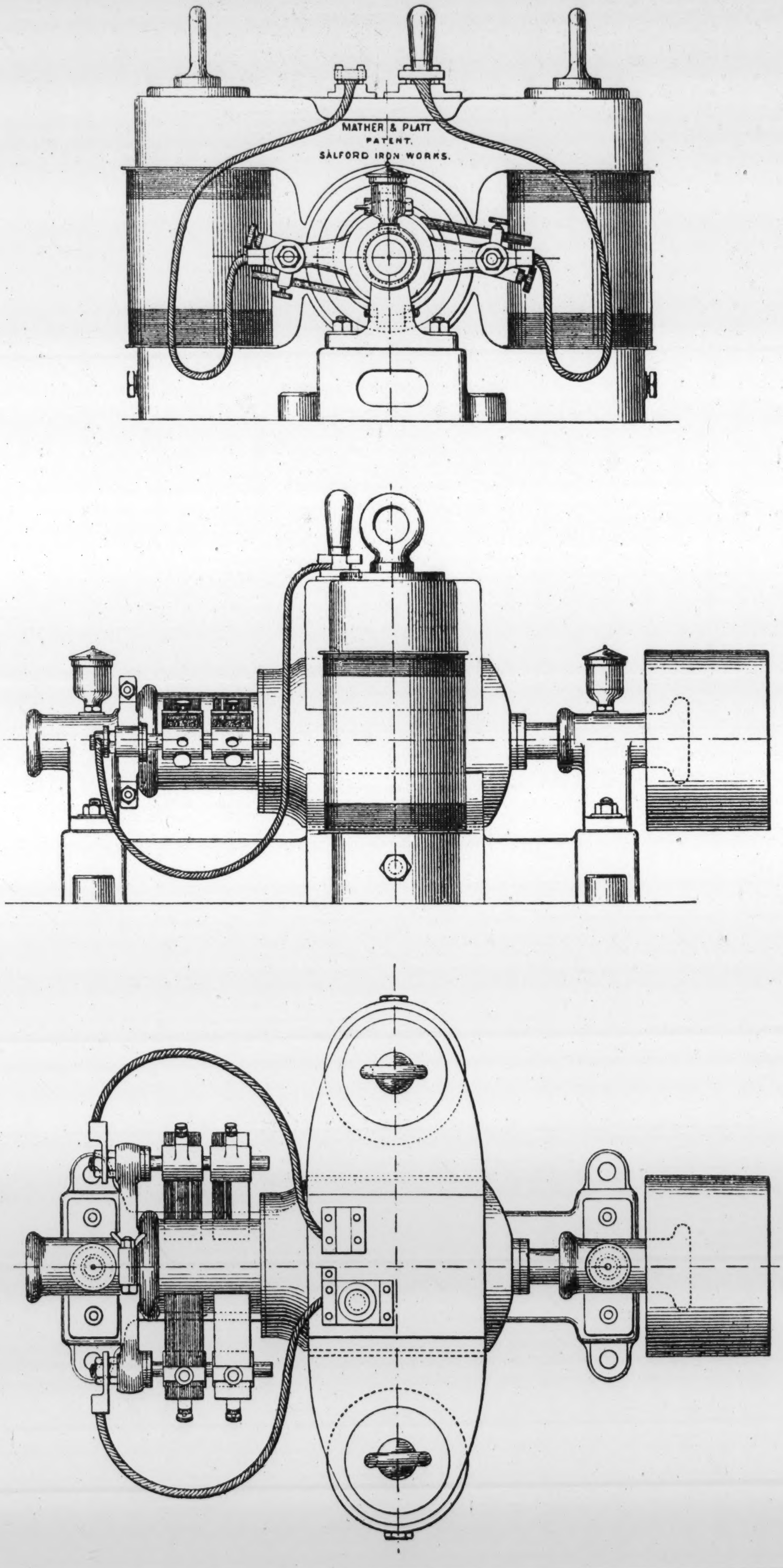
In the machines for 100 lamps, and for higher outputs, there is a double brush on each rocking bar capable of separate adjustment with a spring forward thrust and butt contact. The machines are all compound wound for constant potential at the terminals, the series coils being external to the shunt coils. These changes in the Gramme machine have, we are informed, very largely increased its efficiency, so that the machines of the new type, tests of which we published on the 24th ult., are not much inferior in efficiency to the Edison-Hopkinson machine.

The perfect ventilation and low resistance of the armature enables these dynamos to carry a large load in proportion to the size of the machine without heating. In fact, the load on the armature is determined by quite other considerations than that of heating.

Each machine is provided with a switch board carried on the upper yoke, fitted with a main plug switch and suitable terminals.

Messrs. Mather and Platt are at present manufacturing the following sizes :—

	No. of 20-candle lamps.	E.M.F. in volts.	Current in ampères.	Speed.	Extreme dimensions.			
					Length.	Height.	Breadth.	Size of pulley.
					ft. in.	ft. in.	ft. in.	inches.
1	30 to 40	50	50	1,650	2 3	1 2	1 9	6 × 4
2	50 ,, 60	50	75	1,150	2 8	1 2	1 10	8 × 4½
3	100 ,, 120	100	80	1,100	3 4	1 6	2 4	10 × 6
4	150 ,, 200	100	120	1,030	3 6	1 7	2 6	12 × 8
5	300 ,, 350	100	220	850	4 3	1 10	3 2	14 × 9



MATHER AND PLATT'S NEW DYNAMO.

M. LIPPMANN'S CURRENT METER.

M. G. **Lippmann** has constructed a current meter based on the same principle as his galvanometer, of which latter instrument he explained the theory in a note addressed to the Academy of Sciences on the 19th of May, 1884.

La Lumière Electrique reproduced that note, and gave a description of the apparatus in the numbers issued on the 31st of May and the 14th of June, 1884. An illustrated description of M. Lippmann's instrument also appeared in the ELECTRICAL REVIEW for June 21st, 1884.

The principal feature of the apparatus is a movable conductor, consisting of mercury contained in a U shaped tube and a chamber, with thin rectangular sides, which lies in the magnetic field of a powerful permanent magnet (see fig. 1). The mercury chamber, a, b, c, d, is 3 cm. from a to b and 4 mm. from a to c; the thickness of its sides is 0·3 mm.; the current passes through it by means of thin platinum plates (shown in dotted lines in fig. 1), which occupy one the upper and the other the lower part of the chamber. When the current is flowing the mercury rises in the branch A, and falls in the branch B. M. Lippmann has shown that this rise of the level of the mercury in one of the branches is proportional to the strength of the current.

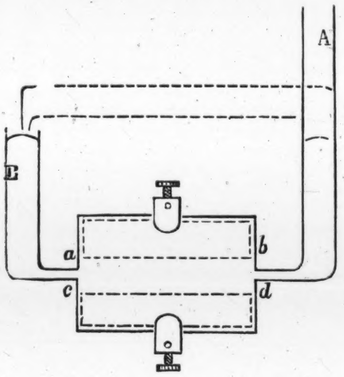


Fig. 1.

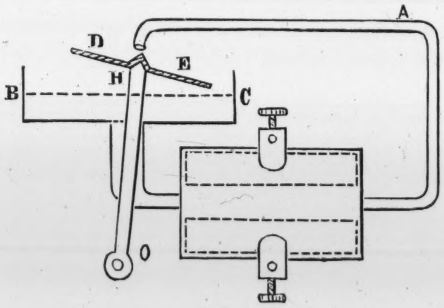


Fig. 2.

It will be seen that if the branch A is bent round at right angles so that its extremity is brought opposite that of the branch B (as indicated by dotted lines in fig. 1), as soon as the current circulates a continuous flow of mercury will be caused, which will be all the more rapid as the strength of the current becomes greater. In fact the quantity of mercury flowing out in a given time will be proportional to the number of coulombs passing through the apparatus.

For the automatic measurement of that quantity the following arrangement has been adopted (fig. 2):—One f the branches has been enlarged and converted into a reservoir, B, large enough to allow the level, B, C, to remain sensibly constant. Instead of allowing the mercury to flow direct from the bent branch, A, into the reservoir, B, it is collected in a small trough, D. This small trough is fixed at the end of a bar, O, H, which is pivoted at O in such a manner that when it is filled with mercury it causes the system, O, H, D, to oscillate towards the left, and pours its contents out into the reservoir. But at that moment a second similar trough, E, comes under the branch, A, and in its turn receives the mercury. When this trough is filled, the other trough having meanwhile emptied itself, the centre of gravity is again displaced, the system oscillates towards the right, the trough, E, empties itself out into the reservoir, and so on indefinitely.

These oscillations to the right and to the left are limited by a fork fixed on the bar, O, H, which actuates an ordinary anchor escapement, by which a train of clockwork wheels is set into motion. This arrangement is shown in fig. 3, which is a perspective view of the instrument as constructed by the Bréguet firm.

The first wheel of the train, that on which the anchor acts direct, carries the pointer which indicates the units.

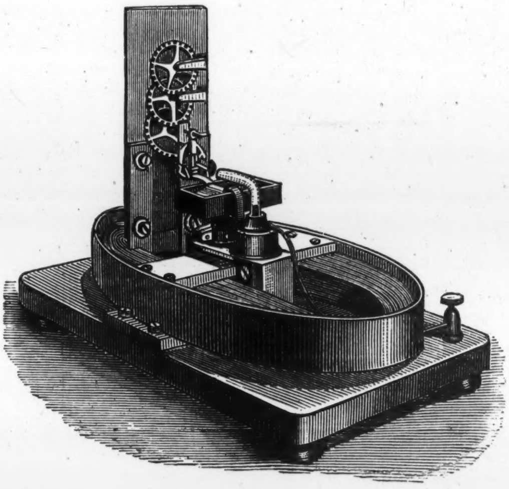


Fig. 3.

The three other wheels also carry pointers, which indicate the tens, the hundreds, and the thousands respectively. Each division on the dial of the units corresponds with a complete oscillation of the troughs system; that is to say, that each emptying out of a trough causes the pointer to advance half a division. The troughs contain each a cubic centimetre, about 13 grammes, of mercury, and under those conditions each division marked on the dial of the units corresponds with 150 coulombs. An ampère hour will, therefore, be represented by 2½ divisions of the dial of the hundreds.

It appears to us (*La Lumière Electrique*) that it would be more practical if the ampère hour corresponded with one division, say of the dial of the hundreds; this would be easy to arrange, as it is merely a question of regulation.

As is also the case with the gas meters, this current meter cannot exceed certain limits in accordance with its mode of construction. The first model, constructed according to the directions of the inventor, can only be used for a current of a maximum of 25 ampères. But in order to enlarge the scope of the instrument it will be sufficient to increase the dimensions of the mercury chamber.

It will be seen that this very ingenious apparatus is the most simple imaginable for the measurement of the quantity of electricity supplied to a circuit, and it will undoubtedly contribute to hasten the solution of the problem of domestic lighting by electricity.

"VITRITE" HOLDERS FOR INCANDESCENCE LAMPS.

MUCH ingenuity has been devoted to designing incandescent lamp holders, considerable advance having lately been made in small improvements in their electrical and mechanical parts. One of the greatest troubles hitherto has been in regard to the platinum loops of the lamps; these being more or less fragile are apt, especially in the hands of the inexperienced or careless, to be strained or broken when the lamps are being attached to, or detached from the holder. The vitrite holder, a new invention, both with regard to material and design, does away with this trouble, there being no strain at all on the platinum connections, whilst the lamp, although held by the hand in fitting in or taking from its socket, can be manipulated with the greatest ease and safety by the most inexperienced person. Vitrite, it may be said, is a kind of glass, perfectly hard and incapable of fusion, except at very high temperatures. It is also unaffected by damp, sea-water, or even acids. In colour it is jet black, and has a smooth, polished appearance. Its peculiar feature is that whilst a first-class insulating material, it admits of the necessary mechanical connections for the conduction of the current, being imbedded in it in process of casting. This very much reduces the cost and in addition to lamp holders, renders it suitable for cut-outs, switches, and other electrical purposes.

FIG.1.

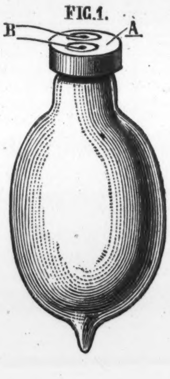


FIG.2

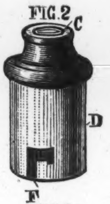


FIG.3.

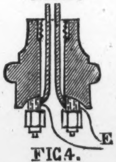


FIG.4.

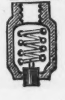


FIG.5.

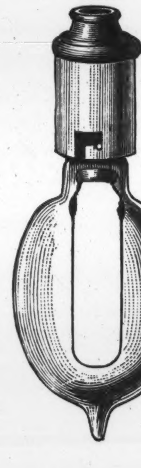


Fig. 1 shows an incandescent lamp with the vitrite cap attached. The cap, A, which is secured to the bulb by a specially prepared cement, has imbedded on the top two metal contact pieces, B, pierced with holes through which pass the platinum wires connected with the carbon filament, and with which these wires make good electrical contact by means of a special amalgam.

Fig. 2 shows an illustration of the holder which consists of two main parts, the vitrite portion, C, shown also in fig. 3, and the brass socket piece, D. In the portion, C, are imbedded two split terminals, E, which receive the leading in wires.

Fig. 4 shows the combination nut and piston spring, which being tightened down upon the wires within the split terminals completes the circuit when the vitrite cap in conjunction with the lamp is pressed in the holder. The brass socket, D, is attached to C, so that it is easily removable. The slots, F, in the socket by which the lamp is held are adapted to serve, if so required, as a switch—turning the lamp to right or to left, turning it off or on. The holder generally is neat and finished in appearance, as may be seen from fig. 5, and being readily adapted to existing installations can be recommended as a valuable accessory to electrical work.

We may add that an improvement is now being effected in the socket so that in the manipulation of fitting, the bulb itself need not be touched, a small projecting collar of vitrite being attached to the socket for the purpose of handling.

The vitrite holders and other vitrite appliances are manufactured by the Vitrite Company, and can be obtained from Messrs. Woodhouse and Rawson's Supply Department, who will also cap any lamps of other makers.

REVIEWS.

Electrical Navigation. (*La Navigazione Elettrica*). By SALVATORE RAINERI. Rome, Turin and Florence: E. Loescher & Co.

The title of this little work does not fully express its nature. There is a chapter devoted to electric aeronautics and, in addition, we find a discussion on certain theoretical points not absolutely involved in the question more directly under consideration. The author quotes, though he does not formally accept, the utterance of Prof. A. Rowland at the opening of the Philadelphia Congress of last autumn, in which he declares that electricity is not force or energy. From this region of speculation Signor Raineri passes on to give an explanation of the system of units now recognised by electricians. This, it strikes us, is scarcely necessary. There is little probability that any person disposed to study electric navigation will be ignorant of these standards.

In discussing the question whether electricity is destined to supersede steam as a motive power in navigation he takes of necessity the negative view, based upon the greater cost of the former. But he claims for electric propulsion advantages which, under certain circumstances, will nevertheless turn the scale in its favour. Among these rank great facility of manœuvring, and the total elimination of the noise of the machine and of the danger of fire. The entire capacity of the vessel from stern to prow is capable of being utilised for passengers, whilst in steamers a large portion is necessarily taken up with the engine and the boilers. On the other hand, he mentions the difficulty which may occur if a sufficient stock of accumulators has not been taken on board, and the cost of maintaining a steam engine for the special purpose of charging the secondary batteries.

Three chapters are given to the consideration of what is assuredly not the most re-assuring portent of modern days, the construction and use of submarine boats. Now as the employment of such boats is substantially limited to one purpose, we may venture to quote the regret of a contemporary that "men, not content with murdering each other on the surface of the ground, hope soon to grapple with each other in the air and to struggle beneath the waves."

L'Electricité dans la Maison. By E. HOSPITALIER Paris: G. Masson, Editeur Librarie de l'Académie de Medecine, 120, Boulevard Saint-Germain.

We have in this work of M. Hospitalier an extremely interesting collection of articles descriptive of the many uses to which electric action can with advantage be made applicable. The whole, or nearly the whole, of the matter has previously appeared, we believe, as articles in electrical periodicals; but the descriptions have been re-written. Books which consist of "paste and scissors" work are not, as a rule, considered to reflect any particular credit on the authors, but such books are, nevertheless, extremely useful, and often require a considerable amount of skill in production. The title of M. Hospitalier's volume is perhaps hardly broad enough to express the actual contents of the 310 pages of which it consists. This, however, is not a fault of great consequence. The general contents of the book are as follows:—Preliminary, The production of the electric current, Electric bells, Automatic fire alarms, The domestic telephone, Electric clocks, Electric lighters, Domestic electric lighting, Electric motors, Electric locomotion, Electro-typing and Electro-plating, Electrical toys, &c., Miscellaneous. It will be seen from this list that a fairly broad field is covered, in fact, the electric telegraph seems to be the only part of the science which is not directly referred to. As is usual in electrical works, the units are first alluded to; but M. Hospitalier has avoided much of the "rigmarole" with which the subject is usually treated, and goes straight to the points of practical interest, and by means of plain illustrations he explains what the values of the different units are, so that a fair idea may be gathered of their dimensions by any ordinary intellect. In speaking of the current unit, he simply states that the latter is given by an electromotive force of one volt flowing through a resistance of one ohm. He then says: "Ordinary electric bells work with a quarter ampère of current, incandescence lamps with from ·8 to 2 ampères, arc lamps with from 5 to 120 ampères. The large machines of Edison can give 1,000 ampères, and certain electro-deposition machines as much as 3,000 ampères. On the other hand, telephonic currents may be expressed in millionths of an ampère." In the second chapter batteries are first dealt with, and very plain and simple directions are given as to the way in which they should be treated in order that they may work properly for a lengthened period. The oxide of copper battery of Lalande and Chaperon receives a comparatively lengthy notice; in many respects this battery is a remarkable one. Electric bells, which are next considered, are not very fully entered into, although the descriptions of the proper wires to employ, the methods of fixing them, &c., are minutely explained. It is somewhat surprising that the ordinary drop indicators, which form such an essential part of domestic electric bell systems, are not illustrated and described. Automatic fire alarms, which are given in the next chapter, have as yet been but little used, though every warehouse of any extent ought certainly to be fitted with them; the apathy of the public generally to the use of these inexpensive but valuable contrivances is not a little astonishing. In the chapter on "Telephones," several descriptions of instruments are explained, none of which seem to come under the special designation of "domestic telephones." In describing "Electric clocks," several interesting points of detail in connection with the methods of making contacts are alluded to. Amongst the "Electric lighters," we miss the latest form of the gas lighter, in which sparks are obtained by Thomson's mouse-mill action; for ingenuity and efficiency this apparatus is very remarkable. "Electric lighting" naturally comes in for a larger share of attention than any other subject, and here M. Hospitalier has shown great discretion in the matter he has selected. Of the remainder of the work nothing special need be said; the information given is all interesting and judiciously selected. Altogether, the whole work does the author considerable credit.

Transit Tables for 1885. By LATIMER CLARK. London: E. and F. N. Spon, 16, Charing Cross.

All those who have possessed themselves of one of the useful and entertaining transit instruments designed by Mr. Clark for amateur use, will require the "Transit Tables" for the present year. The book by itself is of little practical value, and does not call for comment.

Extension of Telephone Lines.—On Monday week the inauguration of a new trunk telephone line between Dundee and Perth took place. The line is about 22 miles in length, and is the first section of a projected line to Glasgow and probably to Edinburgh.

THE NATIONAL CONFERENCE OF ELECTRICIANS, PHILADELPHIA.

(*Reported specially for the "Electrical Review."*)

(*Continued from page* 143.)

Now, with regard to carbon, I am sorry to say that I differ altogether with the view that has been expressed that carbon is likely to replace lead for secondary batteries. Carbons do disintegrate with us in London to a very large extent in the present form of battery. The battery we principally use is a bichromate battery. In that battery the carbons do not last more than 12 months. They do disintegrate; they tumble to pieces; they become quite soft and spongy, and it is quite impossible to use any form of moulded carbon, and we are obliged to use cut carbons, because the moulded carbons will not last more than two or three months. While the cut carbons do not last more than 12 months the lead in the secondary batteries will last more than 12 months. I did not make the statement that the lead lasted only four months. I think it will last more than 12 months. I know of houses where the batteries have been in use more than 12 months, and I am quite satisfied that the lead used in the one I have described will have a durability of more than 12 months. I shall not be the least surprised if it lasts for two or three years.

Mr. Sprague referred to the use of the secondary battery for starting the gas engine. Now I am sorry to be obliged to say that I look upon the employment of such a battery for such a purpose as simply barbarous.

I say this because I believe that the whole, I should not say the whole but the greater portion, of the causes that have brought secondary batteries into such ill-repute are due to the various barbarous practices that have been adopted by those who have been using secondary batteries. These practices have been indulged in without the person knowing the injury they were doing to the battery. The practice has been to dash in a piece of wire in order to see the sparks, and then to say "what splendid order the battery is in." A more iniquitous or sinful practice could not be adopted. It is just like a doctor cutting off a man's head to examine his tongue. Such a practice as that has given the poor battery a straight blow between the eyes, which it will struggle with for days. Any practice that suddenly calls into action the force of the battery, such as short circuiting, is simply barbarous, and tends to destroy the battery more than anything else.

I test every cell of my battery every morning with a galvanometer of 100 ohms. The galvanometer is simply run over all the cells; it takes but a short time, and you can see exactly the condition of the cells without in any way interfering with the condition of your battery.

There is one point about which I should like to have Prof. Dewar tell us a little something. There is one defect, and it is a very peculiar defect in all of these forms of secondary batteries. It follows after a short time after covering the plate with minium, and it is the formation of trees on the plates, bringing the plates in contact. That formation is observable in that form and type of battery, and it is not observed with the Planté. Planté himself has never suffered from the formation of trees, nor have I in the batteries I am using seen the slightest sign of these trees. Therefore I think that the mode of separating to prevent buckling in my case will be a cure. Such a grate as I use would not prevent treeing, and therefore it will not cure that defect, which is one of the most serious defects of the Faure battery.

The inequalities to which Lieut. Jewell referred are due to the impurities of the liquid. I have suffered somewhat in the same way. I have cured it precisely in the same way by putting on the power for 20 hours, and in that way the impurities, or whatever they may be, have been worked out. The result has been that after doing that twice I have had no difficulty for the last two months.

What I am going to do is this. I am going to have my battery in such order that my gas engine by going one day all day long will charge up my battery sufficiently to enable me to keep my house lighted for the rest of the week.

Prof. JAMES DEWAR: My view with respect to secondary batteries, so far as I have been able to look into the question from the chemist's side, is about this. I feel that in the future some other body than peroxide of lead will be discovered, which, I trust, will more efficiently represent the amount of energy absorbed. I take it to be that after all it is a question of relative efficiency of the agents which have been used, we may say, disassociated by the electrolytic action.

It seems to me that apart altogether from the difficulties of conduction, and the question of local action, that the question is whether there are any other bodies likely to be formed, or is it not conceivable that possibly the large class of bodies which can be formed will be as efficient, provided we arrange a definite local action, as we must, to a large extent, in other cases.

Let us take the case, then, of the types of these bodies. We know that in ordinary cases of decomposition, even of the simplest kind, we have two actions taking place. Take the case of the formation of chlorate of potash: $2\,(KHO + Cl_2) = (KCl + KOCl_3)$. Now, as a matter of fact, we have an exothermic and an endothermic action taking place side by side. This action takes place like a majority of chemical actions with a considerable evolution of heat; but the evolution of heat is, in this case, due to the formation of the chlorate of potassium and not to the formation of the chloride. The chlorate itself would be endothermic, or would be minus, or there would be a reduction of the temperature. Therefore the energy for the formation of the chloride is really in some miraculous way extracted out of the energy produced by the direct formation of the chlorate of potassium. Now, this is the kind of body—something like this body—that we want in electrolytic action. We have, by the electrolysis of the water, peroxide of hydrogen with the chlorate of potash. Peroxide of hydrogen occupies the same place that the chloride of potassium does in the reaction. In the case of the electrolysis of muriatic acid hypochlorous acid occupies the same position; it is endothermically formed with a considerable absorption of energy, and consequently can decompose into hypochlorous acid again with the evolution of heat. The same is the case with the peroxide of hydrogen.

If we replace chlorine by iodine we find in the ordinary form an iodide and iodate. There is, if anything, a slight reduction of temperature. That is because the iodide is positive and the iodate is also positive, and this is so much weaker that it would be impossible to form iodate if iodide had been formed by the absorption of energy. If we could construct a battery in which all the oxygen is fixed in this way to an unstable body, there is no question but that we could produce a much higher electromotive force. If we take the case of electrolysis of salts we know very well that in a great majority of salts the electromotive force is practically constant. That accords with the well-known fact that the thermal value of the majority of soluble salts is nearly independent of both the acid and the base. That is to say, it is nearly constant, giving us something like fifteen thousand Gramme units. Some a little higher, but that is not the case with weaker acids. We may say, therefore, if we construct a battery of soluble oxide and soluble acid that the electromotive force is practically constant, because the thermal value is practically constant. If we wish to get a higher electromotive force we must produce a form of this type. Take peroxide of manganese hypochlorous acid, or peroxide of lead. Therefore the question comes to me as to how we may include chromates, chromic acid being some way available, or at least one-third of the oxygen, for this very purpose. Now I take it that the chemistry of this lead battery is not by any means cleared up.

It would seem in the electrolysis of water that you can hardly detect the peroxide of hydrogen. It would seem that the reactions that the chemists have mistaken for peroxide of hydrogen reactions are really reactions which do not belong to it at all as obtained from the electrolysis of water with platinum electrodes, but are obtained from electrolysis of persulphuric acid (SO_4) or some variety of sulphuric acid which is improperly distinguished.

That being the case, therefore, we have to consider cases where we can have converse reactions easily. A type of that kind would be of this order, as in the case of iodides. We take iodic acids, that may be easily formed by the oxidation of hydriodic acid. If we have iodine we may very easily, in the presence of hydrogen especially, get hydriodic acid. Hydriodic acid may be formed from nascent hydrogen and iodine. Only in this case there is undoubtedly a considerable dissipation of energy, because it is not like chlorate, this change taking place with a considerable evolution of heat. I presume that change takes place the moment you mix the hydriodic acid with the iodic acid. It is reactions of that type that we require. For the same water and iodine here you have the hydriodic acid and iodine, and they come back to water and iodine again without any possible derangement. Therefore, it is to the question of getting reactions of this kind without dissipation of energy that I look in the future to the further advance in the construction of secondary batteries.

With reference to one or two points that have cropped out, such as the disintegration of carbon. The same thing is remarkably apparent in compressed graphite even when produced by great hydraulic pressure, and when perfectly pure. If it is used for the poles of the battery in ordinary electrolysis, it degenerates with the most extraordinary rapidity. I believe it is largely due to the mechanical action of gases of the battery on the graphite. The carbon does disintegrate, and the chemical compounds formed seemed to be of the same type as if they were produced at a high temperature. The chemical product seems to be what is called mellitic acid. It has carbon added to it, as it were, with 6 of carbonic anhydride $C\,(CO_2)_6$. It is of the same type as benzole. In fact, it breaks up into carbonic anhydride and then we have benzole produced. That body is called mellitic acid.

The result of the electrolysis is ultimately mellitic acid, and gases of carbonic anhydride and benzole—benzole being the body which is produced when hydrogen in the presence of the electric discharge is produced at a high temperature. With reference to Mr. Preece's remarks in regard to the efficiency of the incandescent light, although it has nothing special to do with secondary batteries, except in their application, it is quite clear that, if what he says is true, and I do not doubt it for a moment, he must be working with an incandescent filament at a very much higher temperature than is customary with the incandescent filament.

If you do not reach the point of destruction of the carbon there is no reason why the efficiency of the incandescent lamp should not be as great as that of the arc. It is not the efficiency of the gas, but of the solid pole at the same temperature. I say there is no reason why the incandescent should not be of the same efficiency as the arc. I do not see anything more in that but what may be of use in this. Some years ago I made a series of experiments as to the increase of the amount of luminous intensity with temperature. I used platinum, but within a considerable range; and since that time the experiments have been followed by others in the same line, and all seem to prove that this is an average and fair way of representing the results, and sufficient, I believe, in the meantime for practical purposes, that if you take a temperature above 500 degrees—of course I take 500 degrees as representing the temperature at which light begins to be emitted—then you may say that as the result of all the experiments that the mean rate of increase of luminous intensity is as the sixth power of that temperature.

Therefore you may say the luminous intensity of a solid is as a sixth power of the temperature above 500 degrees. There is no reason at all why this temperature of 500 degrees is not the point from which to consider the rate of increase of luminosity. Of course we must take that temperature because our vision is imperfect. It is exactly the same thing as we find in cases of the relation of fluid volume. Temperature is simply represented by taking the temperature of the melting point in each case, so there is no reason to say that this temperature, which represents the temperature at which the light begins to be luminous should not be the point at which we should consider the temperature in this case. Therefore in the sixth power of the temperature measuring over 500 degrees, you have a measure of the increase of luminous intensity, and that very fairly represents my own results, and also the experiments of others. This formula enables us to give the temperature of the incandescent filament, and there can be no doubt that the explanation of the efficiency when you work with higher temperatures is simply this—that you work with higher temperature. When you look into the matter, the greater the degree the greater the refrangibility. This is a point of some interest. I still think that there are a great many points in connection with the chemical side of the battery which we have been discussing which we are not in a position really to answer; but sufficient, I think, has been said to point to the direction in which we ought to work.

Mr. **Keith**: I would like to ask Prof. Dewar whether he has investigated, either theoretically or practically, the decomposition and recomposition of the sub-salts of lead, such as were the subject of discussion some time ago. I think he was not present at the time when I stated my own experiments in that line.

Mr. **Dewar**: No. I regret to say that I have not.

Mr. **Keith**: Taking the solution known as Goulard's solutions of sub-salts of lead, which are all very soluble, the peroxide and metal are readily formed and dissolved and re-dissolved in the solution under electrolytic action. So far I have carried them into practical effect only in the laboratory, but I have found that all the electricity is returned as electricity, but, of course, all the energy applied is not returned.

Prof. **Dewar**: The only experiments I have made in that connection are of the same type as many others, namely, that if you take an ordinarily compressed block of pure sulphate of lead, place it on a platinum electrode, and if you electrolyse that, and electrolyse it for hours, you will only succeed in getting a very small quantity of peroxide of lead. As I understand it, the fundamental action is admitted to be that the peroxide of lead is really produced from the sulphate. I do not say it is not produced from the sulphate; all I say is, that if you take a compressed block of sulphate of lead on a platinum plate, and if it is electrolysed for hours, you will get a small deposit of peroxide of lead.

Mr. **Keith**: I think the gentleman misunderstood my question. I want to state here that from solutions of subacetate of lead there is by electrolytic action deposited upon one pole peroxide of lead, and metallic lead is deposited on the other pole.

Reversal of the current in discharge reverses the operation; both peroxide of lead and lead are dissolved.

There is a difference of potentials, say, of one and seventy-hundredths volts.

Lieut. **Jewell**: I would like to say a word or two with regard to the hope that Mr. Preece indulged in. I am glad that he has had such an encouraging experience with storage batteries. I am inclined to think he will be disappointed in the hope expressed of being able to charge the cells on one day of the week and then use them during the rest of the week.

A very simple calculation would convince him, as well as the Conference, that such a plan is not practicable with his present plant. Perhaps, if he increases his plant, he may be able to do it. He cannot do it with that which he has on hand. If we take the figures as Mr. Preece has given us of one candle from 2½ watts of energy, then a 16-candle lamp requires 40 watts, or an efficiency of about 18·6—16 candle lamps per horse-power of electric energy. This, I must say, in the first place, is a little high. Forty watts with 30 volts difference of potential between its terminals gives us 1·3 ampères as the current to each lamp. Now, if we assume that Mr. Preece has, we will say, 10 lamps—put the number small, because 10 lamps are enough for ordinary use—10 lamps will require 13 ampères to maintain them. Thirteen ampères for three hours are 39 ampère hours. I use the term ampère-hours simply to avoid converting the quantity of electricity into coulombs. Thirty-nine ampère-hours, on an average night, for seven nights in the week, are 273 ampère-hours. Now, divide 273 by the efficiency of the storage batteries, 40 per cent., and we get as the total number of ampère-hours during which the battery must be charged, 682½. If we divide that by the number of hours during which the charging will take place, 12 hours during the day, that will give us the current to be used in charging the storage battery to produce this result; we obtain 56·9 ampères at 42 volts, or say, according to Mr. Preece's statement, 52 ampères to ·8 of an ohm. The charging resistance of the battery would certainly be greater than ·8 of an ohm. I call the charging resistance of the battery the difference of tension between the terminals of the battery while the battery is being charged. That is what I designate by the term "charging resistance." The charging resistance, I am sure, from my own experiments cannot be less than 2 ohms, if we shall be allowed to call them ohms.

Consequently the current of his machine will be very materially reduced. Besides that, admitting that he could get this current of nearly 57 ampères, which he requires for charging the battery, the question is how long his cells will stand a current of that magnitude. I am inclined to think that a very few weeks charging with a current so great as that will very soon use up his cells.

Mr. **Preece**: It is a dangerous thing to tackle figures; you can always make them prove anything you like. The assumption he starts with is wrong, for I am only using 10 candle lamps, and they absorb $\frac{9}{10}$ of an ampère. I cannot go through with the calculation here, of course. But my experience shows that I can get 200 ampère hours out of my battery, so I shall have enough to last me a whole week; and the batteries, I am quite sure, after they have been used a little time, will give me that and a margin to spare. I am quite certain, notwithstanding those figures, that if I have the pleasure of coming over here again, I shall be able to report that from one day's charging I have had my light for a week. On one occasion I had, without any further attention to the battery as it stood, sufficient light for two dinner parties and four days.

And I think that, as we did that in an emergency, with a little gentle care that can easily be given, I am not far wrong in saying that I shall be able to have enough for a week's use.

Mr. **Koyle**: I believe Mr. Preece said that in England the result he obtained by the use of gas was, that it took 62 watts to furnish one candle power and it took 2·5 for an arc lamp. Some calculations made two or three months ago, made me wonder at this. The calculation will take but a moment. I think that the result arrived at is entirely erroneous, and for the sake of the public at large, who, think because we are assembled as an electrical conference, we are talking very high, I would like to present it. One ton of coal will furnish at the most 30,000 cubic feet of gas.

Mr. **Preece**: Excuse me, I think you are wrong in your first figures. A ton of coal produces 10,000 instead to 30,000.

Professor **Rowland**: I suppose that the 62 watts and the 2·5 are in the terms of heat. In the transformation of the original heat through the steam engine there is a loss of all but 10 or 12 per cent. I do not think there is any necessity of making the calculation, for one is in terms of heat before it is transformed.

Mr. **Koyle**: I think it quite likely that is correct.

Mr. **Sprague**: I wish to make one correction in the statement of Mr. Preece. He accused me of a barbarous practice in starting a gas engine by closing the short circuit of a storage battery. I referred to something which happened in a private house without my advising it to be done. On the contrary, I do not believe in storage batteries, and I am not a friend of storage batteries and do not recommend their adoption. I would suggest to a person who is going to start a motor in that way that it is easy to shut down to one and five-tenths volts of a storage battery. It would be a better practice to introduce a resistance in the circuit of that battery so that in passing the current through the dynamo no current can possibly pass through that would damage the battery. There would be very much less current. To any one who had the trials and troubles of starting a gas engine of from 2 to 40 horsepower, I think that they will agree with me that if by electrical or mechanical means we can start the gas engine, say, by sending part of our current back through a motor without damaging the battery in any way, we have a great boon. Any practical electrician will agree that it is better than expending 10 to 20 minutes in trying to get the gas engine started by purely muscular effort.

Mr. **Preece**: Let me remark, that now all gas engines are fitted with self-starters; every gas engine I have seen has an extremely simple mechanism called a self-starter, by which a child can start the engine by pressing the tap of an ingenious device by which a cylinder buried underground is put in operation. This cylinder takes a mixed charge of gas and air under pressure of about 100 pounds and by the slightest movement of a tap sufficient power is developed by an explosion in the gas chamber to immediately set the gas engine in motion; so there is no need of using secondary batteries, nor any other means of starting.

Mr. **Sprague**: I spoke of what had been done. At the time I spoke of no self-starters had been used. Mr. Schlumm, who was making the Otto gas engine, had not then made a self-starter. I do not think there is any gas engine in the United States that has this self-starter. Of course if anybody has a self-starter he can use it.

Professor **Forbes**: I only want to ask if there is anyone here who will tell us more about the testing of secondary batteries. It is a point upon which I have sought to hear some remarks. I have already spoken, and I do not like to speak upon this subject again. I hope somebody will make some remarks about testing secondary batteries. In my own opinion no test has ever been made as to the efficiency of the secondary battery which was a scientific test. In order to have the test efficient, you must know what you put in and what you get out. You must leave the battery in exctly the same condition, electrically, as it was when you started with it. I believe these conditions have never been fulfilled. I do not think that a single efficient test of a secondary battery has been made.

THE DISTRIBUTION OF ELECTRICITY.*

In the last lecture I was engaged in describing the different methods which have been used to apply what is called the multiple arc system of electric lighting. The multiple arc system is a system in which there are one positive and one negative lead between which the lamps are placed. I think that we succeeded in arriving at several very general conclusions which simplify the consideration of the manner of laying mains a great deal. I think I am right in saying that in the past the practice of designing mains has been to a certain extent haphazard; the mains have been selected a little at random, and then perhaps afterwards adjusted to a slight extent; but there has not been that thorough calculation and estimating of the effects which could be done by calculation, and in consequence of that there have been some grievous failures in electric lighting on the multiple arc system. I think we arrived at one or two important generalisations which must be accepted as necessary for economy, and in such a system —the multiple arc system—the amount of copper used in our mains is so enormous that everyone must admit that economy is the first consideration, and that all engineering difficulties that there may be must be met by the engineer as difficulties which can be conquered. The most important results which we arrived at were, I think, pretty clearly shown by illustration by this diagram of the city of Chicago, as we chose to call it, in which it was shown that in order to have good distribution there must be no great variation of pressure in the mains, electric pressure in the mains corresponding, as you will remember, exactly with hydraulic pressure if it were a service of water; and in order to prevent our having too great a variation of pressure in different parts of the district, or in the same district at different periods of the night, when the consumption over the district varies, it is necessary, as I showed by means of this diagram, to have a large number of distributing boxes with figure mains, trunk lines of conductors coming to these distributing boxes and feeding them, and each one of these distributing boxes then serving to light up a certain space, which in this diagram is essentially a triangular space. And I also gave you the rules for determining what is the size of the district which may be lighted up by such a distributing box, and I think everyone here will agree with me that the limit was very confined indeed compared with the general ideas which have prevailed as to the number of distributing boxes which are required; that is to say, that upon the assumption upon which we have been going of the size of conductor required to carry a certain current, we concluded it would be necessary to have the distributing boxes so close that no lamp should be at a greater distance than 124 yards from the distributing box. Another important point which has been, I think I may safely say, altogether neglected in all schemes which have been hitherto issued for distribution of electricity from central stations is this, that the distributing box, the point from which the distribution takes place, must be closer to the central station than any of the lamps which are fed by that distributing box. As a general rule, the distributing box has been put in the centre district which it feeds, and that is a mistake; it ought to be nearer the central station than any of the lamps which it feeds. I gave you also in the last lecture some account of the relative cost of different systems of lighting in the multiple arc way, and it was found that by introducing a large number of distributing boxes in this way the cost was very materially reduced; but, at the same time, the cost was very great even with these distributing boxes. And the cost may be divided into two parts, first, the cost of the supply wires, the conductors which are supplying the electricity from each distributing box to the houses, which are represented by the square lines round each block of buildings there [fig. 2, p. 145, Electrical Review]; and secondly, there is the expense of the feeders, the conductors going up to the distributing boxes. Now when we increase the size of our district to any considerable extent, the cost of these feeders, these trunks which carry the electricity to the distributing boxes, is far greater than the cost of the supply system of conductors. If there be a means of reducing the cost in this way, that is to say, any way of cutting out these feeding conductors, that will be a very great economy indeed.

This evening I will leave altogether apart the system of multiple arc lighting, which is the system which has been almost universally adopted in the past, and I shall speak this evening about the different systems which have been proposed and partly carried into effect for using higher pressure in the mains. The work which is done by a certain number of lamps is a perfectly definite amount of work, and it is measured by the product of the pressure of the electricity—the product of the quantity of the electricity which flows. If we increase the pressure we diminish the quantity of electricity that flows; that is to say, we diminish the current, and if we diminish the current we can diminish the size of our conductors.

Now a great deal has been talked about the danger of introducing high pressures in electric distribution. I think that I shall find general agreement among competent people when I say that a great deal of what has been talked in this way is pure nonsense, and that high pressures are not in the least more dangerous than our present systems of illumination; that if we have to bring high pressures of electricity through a district, those pressures are confined to the wires, and it is only in the case where there is disgraceful negligence of duty, and a disgraceful leakage towards the earth in some part of the system, that it is possible for anybody to receive a dangerous shock from the wires of such a system. The wires which conduct the electricity into a house of any of these high potential schemes can never have a greater difference of pressure between them than what is required for the lamp; that is, in the present state of affairs, something like 100 volts. We will say that is the highest pressure there can exist between the two wires, and it seems almost incredible that there should ever be allowed to be a leak in the system so great that when a person touches one of the wires he should have a high current flowing through his person which would be dangerous. If we are to abolish the idea of using high potentials simply because of this vague notion that some time a shock might be experienced, we might as well abolish the whole system of gas lighting because it is possible that people can go into rooms where there is a leakage of gas with a lighted candle. The danger from gas is infinitely greater than that which can ever come from high potential electricity, and the difficulty of detecting a leakage of gas is likewise infinitely greater than the difficulty of detecting a leakage of electricity. A properly organised system of distribution of electricity at high potential would render a severe shock to any person absolutely impossible, and that is the point which needs to be dwelt on very strongly at present, because so much has been talked, and so much nonsense has been talked, about the dangers of high potentials.

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* Cantor Lecture delivered at the Society of Arts by Prof. George Forbes, February 16th, 1885.

I have often found a great convenience in describing the effects of electricity and the systems of distribution by reverting to the analogy of water pressure, and, I think, those of you here who are not deeply conversant with the subject of electrical engineering will perhaps be assisted by a few words of reference to the analogy of water pressures. At present we see through different parts of London pipes being laid for supplying power by means of water at high pressure. This water is utilised in motors or turbines, through which the water passes. The water pressure is remarkably analogous to the pressure of the electricity in our mains; the turbines or other motors which are used to develop the power have remarkable analogy to the incandescent lamps or the arc lamps, or the electric motors which may be used with a system of distribution. Now, in the manner of laying pipes which we have all observed in the streets in London, all these turbines or water engines are connected directly on to the same set of pipes; in other words, they are all connected in multiple arc, as we would say in electric language. But it would be quite possible to conceive of two turbines connected together in series; that is to say, with a very high pressure in the mains first driving through one of these turbines, and then the outflow of water from that turbine still admitting of considerable high pressure to a second turbine, which it should work with the superabundant pressure which should exist. This is exactly analogous also to the electric system of distribution in series; and this will be clear by examination of this diagram (fig. 1), where this circle represents the dynamo machine with the two leads coming from it, and here are a number of circuits, each circuit having two lamps in series. This is exactly equivalent to a main to come along here, split into a number of water pipes with two turbines put in series. It follows that the pressure of water required to drive these two turbines is double the pressure required to drive the one. So it is exactly the same in electric distribution. We simply have to increase the pressure when we put a large number of lamps in series.

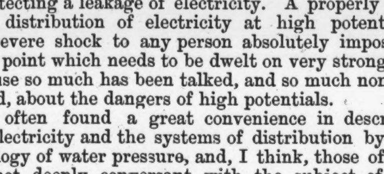

FIG. 1.—MULTIPLE SERIES.

Now, there are several different ways in which high potentials can be used effectively and with economy. I will begin with mentioning the probable future which there may be in the application of secondary batteries. We often hear it remarked that the present systems of electric distribution are weak in some points, and that if only a system of secondary batteries were introduced everything would be clear, and there is no doubt that by introducing secondary batteries a great deal of facility is given to the scheme. In the first place you can have a much smaller engine power, much smaller dynamo power, because your dynamos can be working the whole day charging these accumulators, and only used for supply when it is required. In the second place you can put your secondary batteries all in series over a large district and charge them up all in series, and then discharge them each to its local district, a small number at a time, and a small number at one place. In this way, by using high potentials, of course we should use small currents. In the hydraulic analogy by using high pressures we require a smaller volume to flow, and therefore we should require smaller conductors, and consequently there would be a saving in laying down our copper. This is perfectly true, and there is not the slightest doubt a secondary battery system is of the utmost value, and would help us enormously. But at the present moment there are several difficulties in the way of introducing secondary batteries like this, and the first is perhaps the most fatal one, and that is that we have no secondary battery. I do not mean to say that a great deal has not been done in the last four years in improving secondary batteries: it is my firm belief that a very great deal has been done even in the course of the last year in improving secondary batteries; but at the present time we have not sufficient confidence in the action of secondary batteries to justify any engineer in depending upon them in designing a scheme of distribution. But I must say that there is a great probability of something being done in this direction, because there is such a vast amount of intellect in the whole world being devoted to this particular line, trying to perfect it, and already I have seen such enormous improvements in secondary batteries of late that I cannot help thinking that very likely soon we shall arrive at something much more near perfection, and for this very reason I consider it is of the utmost importance that engineers should consider all such schemes which enable them to use high potentials, because, even though at the present time such a scheme as that introduced is imperfect to a certain extent, those schemes which lay down small wires for using with high potentials are the very schemes which will become applicable when the secondary battery is really a commercial thing in our possession; and, therefore, any person who has at the present moment to lay down a large system of lighting with the multiple arc system would perhaps find in the course of a year or two that the whole of this enormous cost of copper he had laid down would be utterly wasted, because some discovery which had been made would enable him to use smaller conductors. For this reason I consider in designing a scheme of electrical distribution an engineer should consider the great importance of a probable discovery in the way of secondary batteries.

There has been one large experiment in the way of secondary batteries made at Colchester, and I have got diagrams here showing schemes of electrical distribution. With respect to the diagram at the other end of the room, which was referred to in the first lecture [fig. 1, page 123, ELECTRICAL REVIEW], I would simply say if you have troughs, or good-sized channels in which your conductors are laid, there is very little difficulty about your insulation; with a good branch system and plenty of room the engineering difficulties are comparatively trivial, as long as you will remember the facts which I pointed out in my first lecture, that you are not to trust to your insulating material as the support for the conductor. Your conductor must be supported by a substance capable of supporting it, not by a bituminous compound through which the conductor will sink in the course of ages. But there are no engineering difficulties if you are able to have a trough for conducting your wires, and I am perfectly of opinion that if you have the mains laid down in that way you can use your 5,000 volts with perfect facility and there will be no danger, and with proper tests regularly made, such a system would not only be possible but perfectly safe. With respect to this long diagram [fig. 2 (rocking switch)], it shows the arrangements which are made at Colchester by the South Eastern Brush Company for distributing their electricity. The dynamos with the charging mains act through what is called a rocking switch into the secondary batteries. Now in this supply system, first we have charging mains coming to the secondary batteries situated in different districts through the town, and then from the secondary batteries we have service mains going away to different houses which are to be supplied, and this rocking switch is controlled by what is called the master cell, which is simply a cell with a diaphragm, so that when the ebullition of gas becomes too great, the diaphragm is raised and the contact is made, which switches over this rocking switch, and the cells then being considered to be thoroughly charged, are transferred from the charging system of mains to the service system of mains. That is the arrangement which was adopted there. One of these cells which are used there is shown here, one of the Consolidated Company's cells, which I have lately had the opportunity of testing very carefully, and which seems to give fair results; and I have upon the table below two plates, a positive and a negative plate, and you can examine them and see how they are constructed. Let me put in a word here in parenthesis. I do hope that those who are electricians will not allow the term negative to be applied to what ought to be positive, and the term positive to what ought to be negative. I cannot understand why, since secondary batteries have been introduced the whole language which electricians have been accustomed and got habituated to should be utterly reversed, and if certain companies who make these batteries persist in calling the plates in that way I don't see why electricians should adopt them, and why they should not stick to the terms they have been accustomed to use. I only hope a word put in in season here and there will lead to electricians insisting on proper terms being given to these plates. Here also I have some plates well worthy of examination kindly lent me by the Electrical Power Storage Company. I may say that I had the good fortune to look through the work they have been doing of late, and I have been very much struck by the enormous progress they seem to have made in the practice of the construction of cells and the maintenance of them in good order and the prevention of the sulphating of these plates, which has been a source of very great trouble; and one of the chief things I was shown was the way in which these negative plates are kept in good condition, and how it is impossible to injure them, apparently, by over charging. I believe I am right in pointing to this one (indicating a cell on the table) as one which has been persistently over charged with the idea of trying to damage it, trying to make it worse, and if you look at it you will see as good a plate as you ever saw in your life in any secondary battery, the material perfectly sound and excellent. It really seems to show that one of the chief difficulties that has been met with is charging with too weak a current and allowing the battery to degenerate and not keeping it thoroughly charged up.

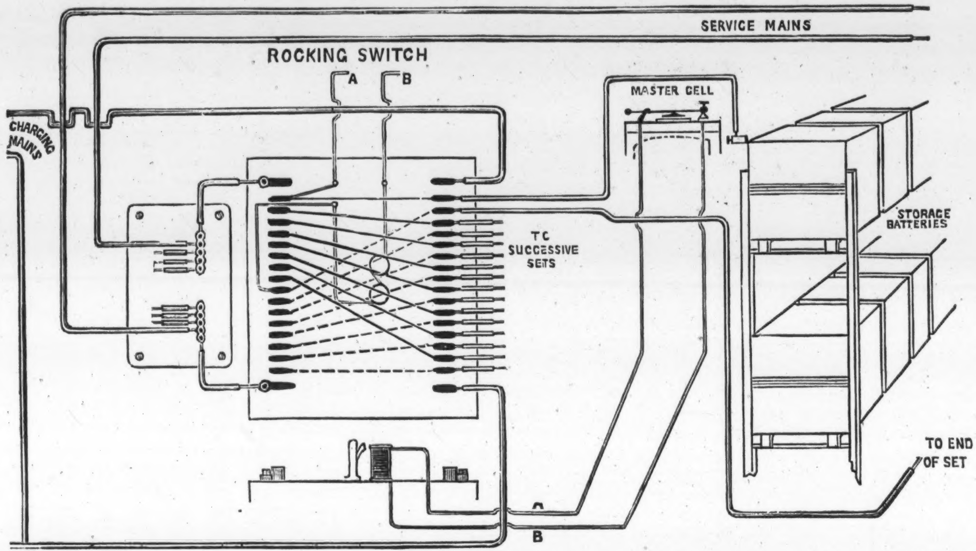

FIG. 2.

Next, I wish to draw your attention to a system of supply with high potentials which has been introduced by means of secondary induction currents. It is a very old idea indeed to use induction currents in order to use a high potential current in the mains, and a low potential current in the supply service. I believe that the first patent which I have come across which was taken out in connection with this, was by Mr. Harrison, in the year 1857, and since then it has been patented over and over again, and here is a general idea of it shown in this diagram (fig. 3),

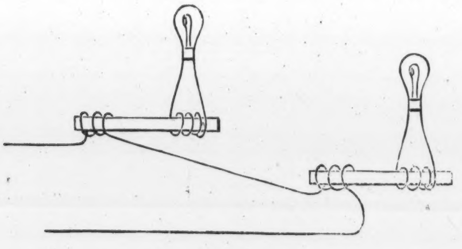

FIG. 3.

where there are supposed to be rods of iron (indicating) surrounded by coils of the main wire; here is the main wire coiling around one end of these iron bars. The lamps, then, are connected, their terminals, by a wire which coils around the iron bar also, an alternate current is used to pass through these main coils, and it sets up alternate magnetisation in opposite directions by these iron bars, and the magnetisation induces electric currents in this wire which is connected with the lamp, and consequently we are able to magnetise this bar by the main wires with any potential that we please, and we are able to draw off by these induced currents a current of any potential that we please. In this way different lamps in different parts of the circuit can be fed with a current of whatever pressure you please, although the main exciting current is of very high pressure indeed; but, mark this, there is absolutely no danger in this system, because the charging current is in a closed circuit which never goes near the rooms where the lamps are actually at work; a lamp thus never has over the potential which is required for that lamp, and the high pressures which are used in the mains are confined simply to a closed circuit of wire; therefore there is absolutely no danger in such a system. I have said that this is a very old system. The idea is very old; but it is only in the last few years that it has been worked out practically and with confidence, with a confidence that does honour to M. Gaulard, I may say, for the way in which he has attacked this problem; he was confident from the very first. I think it was three or four years ago when we first saw his apparatus in the Westminster Aquarium; since then he has been improving it, and has brought it to a practical issue. Since then I have not myself had the opportunity of experimenting upon those apparatus, but I simply draw my conclusions from the reports, in the first place, made by Dr. Hopkinson and others; and I have not the slightest doubt that from these secondary generators it is possible to get a return of 90 per cent. in the lamp circuits. This is a result which is very remarkable, and is worthy of far more serious consideration than it has received up to the present time from most people, though of course many advanced electricians have been looking with eager interest at the result of these experiments. During the course of the last summer experiments were being made, as most of you are aware, at the Electrical Exhibition at Turin,* and I have here a plan of the scheme which was used there, and of the way in which the wires were used. Altogether the circuit had a length of about 50 miles; and we have evidence of the large number of different kinds of lamps used upon that circuit—a large number of Bernstein, Swan, Siemens, and Edison lamps—a large number of different lamps of different pressures, all worked from that central station over that great distance, so that the matter of distance is apparently overcome; these distances were of course much greater than they would be in any town distribution. I don't think I will say anything more about the system just now, except this, that if there is no difficulty about the expense of it it is well worthy of far more attention than has been given to it up to the present. I had the pleasure of looking at the installation which is being commenced at the Grosvenor Gallery the other day, and I see there is no doubt we shall have an opportunity very soon of seeing a very large installation there, and at the Inventions Exhibition there is going to be a considerable amount of work done by the same system. After those two experiments we shall be in a position to judge whether economically it is good. In every other point, except perhaps the induced currents which the alternate current machines may create in telegraph wires and other circuits, there really seems to be no objection to the system. It is true there is a great objection to alternate current machines, but when we come to examine it there is very little to be argued against it; if the leading and return wires are brought very close together induction in neighbouring telegraph wires is small, and I really think that we ought to look—all electrical engineers ought to look—very closely into these experiments which are being made just now, for it really promises well.

Now let us go on to the other systems, and which are more analogous to those which we have been describing previously; and first, let us speak of the multiple series system. Here is a system, which I have alluded to, of multiple series on which there are two lamps on every series. (Fig. 1). Now the trouble of that was, when it was first introduced, that if one of those lamps went out the other in the series went out. In order to prevent that, it was suggested to bring a wire connecting the intermediate position to all the lamps in the circuit. Then if one goes out the other does not, because it is fed by the current coming from the other lamps. The sketch shows that very well by the dotted line. Another example shows it in a different manner. There we go through successive pairs of lamps, the pressure gradually falling as we go along, and pass through the nine different series connected up. I do not know when this system was first proposed; it is very old, I believe. The first time that it was practically seen in action was, I believe, at the Paris Exhibition of 1881, when Mr. Edmunds lighted the Congress Salon by Swan lamps, the lamps all being fitted in multiple series in this manner. After that the most important experiments made were those by Mr. Preece at Wimbledon last year, when, in some experiments he made for the Commissioners of Sewers, he lighted up a large part of Wimbledon with incandescent lamps, all on the multiple series system; and quite lately we have had brought before our notice by Mr. Kierzkowski-Steuart an admirable account of the lighting of Temesvar, in Hungary, by means of a multiple series system like this, in a very remarkable article which appeared in a recent number of *Engineering*, giving a detailed description of the arrangements there, which had undoubtedly been worked out with very great care before laying down the installation. Now, the multiple series system is one which is admirably adapted to certain cases; it is admirably adapted to Temesvar, in Hungary, because it is only used there for street lighting, and the lights are always all required at the same time. But it is not suitable for house-to-house distribution, simply for the reason that if some of the lamps are put out, then the other lamps on the circuit have too much current. Having shown by experiment how this would act, the lecturer proceeded: Now that would be intolerable in a general supply of electricity; that when one house in a block of buildings was using rather less current than usual other persons in that block should get far too much current would be intolerable, and that the next block of houses should receive so little current as was shown by these lamps (in the experiment) would also be intolerable. Various devices have been proposed for getting over these difficulties. I will deal with one or two. The first system which I shall speak of is one which has already been put into practice, and it is undoubtedly a most ingenious principle. That is what is called the three-wire system, which Dr. Hopkinson originated. [A fully illustrated description of this may be found in the ELECTRICAL REVIEW for January 10th of the present year]. There we have two dynamos at the central station working in series, working through each other; that is to say, in the hydraulic analogy two pumps working in series so as to send the water from the pumps at a very high pressure, if such a thing could be introduced into hydraulic engineering. The supply mains come from the extremities of two wires, but there is a third supply main which comes from the intermediate point and connected between the two dynamos, and the lamps are attached to branches which may come from the first main to the intermediate, or, as it has been called, the compensating main, and some of the lamps are attached to branches which are connected with the last main and the compensating main in the middle. By this means we are able to use twice the E.M.F., twice the pressure, by using the dynamos in this way. Of course a great difficulty, as I have mentioned, would occur were it not for this central connection of the compensating wire; if there are more lamps in use in the first series than in the second series, then it would be necessary to drive the first dynamo so as to give a greater current than the second dynamo is giving, and then by adjusting the pressure of the two dynamos we are able to give a constant supply to both sets of lamps, and at the same time to work them in series. This line here is supposed to represent a point of very large consumption, such as a theatre, when the wires come some from the first main and the compensating conductor, and some from the second main and the compensating conductor, but in about an equal number, so that if the theatre is put out of a sudden the disturbance in one series of mains will be the same as in the other, and there will not be that change in the light shown you just now.

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* For full particulars see ELECTRICAL REVIEW for January 10th, 1885.

Now as to the economy of this system. In the first place you will notice that as I have arranged it here, which is the manner in which Edison has used it, the fall of potential is at the same rate as it is with the ordinary multiple arc distribution, therefore, according to this way, in which lamps are led off from two pairs of mains at every part, the distance to which these mains can extend is still limited, as it was in the multiple arc system, to 124 yards. But it would be equally possible to use only the first main and the compensating main up to a distance of 124 yards, and then to use the compensating main and the second, the lower potential main for another 124 yards. Now as to the economy. A great deal of exaggeration has been introduced in America into the accounts of economy in this system. It has been said that since you are using only half the current when you double the number of dynamos, therefore you have half the size of mains; but then you have three mains instead of four, therefore, they say, you have a gain of 25 per cent. for that reason; but then, they also say, you have got twice the pressure you had before, and again you may halve your mains, and altogether, they tell you, you can make a saving of copper of 62½ per cent. Now this may suit American financiers, but it is not electrical engineering. As a matter of fact in the two cases, in the place of having one dynamo and one pair of mains, I introduce two dynamos and three mains. I have half the current passing through that wire, and, therefore, I may have half the diameter of it, but there is no further reduction possible. I assume that I may take it for granted that the axiom which we worked out in the first lecture must be accepted as an axiom in all future time, that is, that to get economy in our mains we must use the most economical size of conductor possible. In that case the size of conductor is simply proportionate to the current it has to carry; therefore, the total amount of copper you have to lay down is simply three-fourths of the mass of copper which would be laid down in an ordinary multiple arc system. At a meeting of gentlemen interested in electricity lately, this subject was broached, and I ventured to mention this point then simply because the originator was present, and I may say that Dr. Hopkinson thoroughly coincided with me in the views I have given you, so that it is evidently purely an American idea.

If we increase the number of wires from three to a larger number, then we increase the economy, but if all the wires are of the same size, then the limit of economy, the maximum economy would be to reduce the copper by one-half; but it is possible to reduce the compensating wire to one-half, and I should think it might be reduced to one-half, and in that case the limit will be one-fourth; that is to say, when you put a large number of series you will have about one-fourth of the copper which you have otherwise in a multiple arc system. However, if we wanted to be absolutely certain that our lamps would be in perfect working order, and that our conductors would be of suitable size, perhaps it would be right that all these three conductors should be of the same size, because such a consumption might arise. I am not of this opinion, but suppose we say that, then would come the question whether it is not possible to devise some other means of reducing the thickness of these intermediate wires, these compensating wires. And this is what Mr. Edison has accomplished, on paper at least. In a very interesting patent which he took out in 1883, he has described a means of switching over the lamps from one pair of mains to the other. Now I believe there is a great deal in this, and I believe it is possible in this way to make the householders themselves regulate their supply to a great extent, Just think what you do with your own gas; when you first light your gas, if your burners are as bad as burners usually are, your light flares, and you have to turn it down; after a time, when everybody else is using the gas, you have to turn it up again; then, late at night, when everybody has gone to bed, and you are hard at work you require again to lower it. If every householder had a switch so that he could switch his own lamps on to one pair of mains or the other, when he found his light dull he would fiddle away with his switch, and in that case he would not only make his own light better but everybody else's, and every person in the district would be helping the others to acquire the right potential. No knowledge of electricity is required; no householder has to know what he is doing; he has simply to follow the natural instinct which a householder has of fiddling with his gas jet until he gets it the best way possible, and thus it is just possible that to some extent that may be of use. Mr. Edison proposed to use this system of switches, with the three-wire system in combination with it, so that he will not get a perfect compensation by either the one or the other; by the combination of the two he will get a perfect system and a perfect compensation. He has also proposed, in the same patent, to introduce automatic switches, switches which may be influenced by the pressure of these mains locally, or switches which may be influenced by the person in charge at the engine house, so that wherever there is a deficiency of potential lamps may be switched over. It is very probable that some development on this line may lead to important results. I have myself tried to extend the system a little, not in connection with the three-wire system, but in connection with the simple two-wire system.

Now what is necessary in order that we may have equality in current in different sections of these series? It is necessary that we should be able to switch over one or more lamps, or one or more houses supplied with lamps from one to the other. Now what I should propose in this system would be the switching of the mains over. In this case the main, which is connected to each house, is broken between each pair of houses, and I can connect them simply by putting the second main there to the left, the fourth to the left, the sixth one to the left, and so on, and doing the same with the negative main I should get exactly the same distribution, and I could vary with such a system as this the number of series that there were; I could connect half a dozen of these branches of mains together, and then 12 of these below, and then go on in the same way, from step to step, and introduce only two or three series in the whole of this circuit, or I might introduce as many as 20 or 30, just as I pleased. If one had a very long circuit over a lamp district, one might arrange them in any number of series one pleased, and one could switch over a house from one main to a main of higher pressure, or from a main of high pressure to a main of lower pressure.

Now the time has come when we must conclude this course of lectures, and in conclusion I have only to say that I think you will all agree with me that when we attack the problem of electrical distribution in a serious vein we find that it is rather simpler than it seems at the first blush. It has been well said by one of our most distinguished electricians that in the past the distribution of electricity has been the *crux* of electric lighting; it has been there that the difficulty has been. Undoubtedly the Electric Lighting Act has done an enormous deal to hinder electric lighting, but every electrician must admit that there has been a difficulty in the question of distribution; and, I think, you will all agree that the further we go into it the simpler are the rules which guide us, and it is only that schemes have generally been commenced in a slightly haphazard fashion that difficulties of a serious character have seemed to present themselves. In every special district the engineer must use his discretion as to the kind of distribution which he is going to employ. But even in large districts, I think you will all agree that the consideration we have given to it shows that it is a possibility to lay mains on economical principles which shall suffice for lighting large districts, if no undue hindrance is put in the way of enterprising undertakers by the authorities that are in power. The past history of electric lighting has chiefly dealt with the system which I first spoke of in my last lecture, the multiple arc system, but I do not hesitate to say that the future of electric lighting, on a large scale, will deal almost entirely with the systems which have been touched upon to-day. And especially I would draw attention to these different schemes and their value for the reason which I have already mentioned, that in the future we may have inventions in secondary batteries, or we may have other inventions, but whatever invention there is favouring electric lighting, it will be of a nature suitable for using the thinner conductors which we would naturally lay down with any high potential system which I have spoken of this evening. Therefore, the engineer in designing a system of mains would have a natural bias towards such thin conductors, such high potential mains: for that reason he would advise it as well as for other reasons. When we are able to use, as I confidently believe we shall, a pressure of 5,000 volts, we can diminish the thickness of our conductors to $\frac{1}{50}$th part, and for a district of 50,000 lights we should only require a conductor of about an inch section of copper. When we are leaving the idea of masses of copper of the size of a man's body and coming down to masses of copper an inch or even two inches in diameter, I think we are really coming to the question of practical electric lighting. And all this has been done—is not merely theoretical; it has been done to a considerable extent already, and that is the direction in which progress is being made at the present time.

I can only say that I hope the Parliamentary difficulties which have partly stood in the way of electric lighting in the past will soon be entirely removed, and that others will prosecute the question of electric distribution, so that we may be all thoroughly ready for it when we have greater facilities for electric lighting in the future, because there is not the slightest doubt that the question of distribution had not been sufficiently developed when the Electric Lighting Act was passed, and if we are ready in the future when those great concessions which must be granted by this or a succeeding Government—because it is simple justice—when those concessions have been granted, let us trust that engineers will be perfectly ready, and be able to supply a scheme which is perfectly satisfactory. (Applause.)

Mr. PREECE, in proposing a vote of thanks to Prof. Forbes, took the opportunity of endorsing what the lecturer had said with reference to the danger of high potentials. He was quite sure that electricians were far more able to protect the public from even 50,000 volts than gas engineers were to protect the public from explosions, or ordinary steam engineers from bursting boilers.

Prof. FORBES suitably acknowledged the vote of thanks.

NOTES.

To Our Subscribers.—It is particularly requested that in sending subscriptions by postal orders from countries (such as Belgium, Italy, Norway, Denmark, and India) from which the *postal authorities* transmit the order, a letter of advice be always sent us direct; otherwise we are prevented from ascertaining, and crediting the amounts to, the senders.

Lighting of a Turkish Bath.—The Turkish bath lately opened in Savoy Street, Strand, W.C., is lighted by 57 10 and 20 candle Woodhouse and Rawson incandescent lamps, Tayler-Smith's fittings being used. The current is supplied by a 60-light Elwell-Parker dynamo, with an 8 in. armature, driven at about 1,200 revolutions a minute by a 4-horse Clark horizontal gas engine. The dynamo is sufficient to generate all the current required; but there are also 26 1-horse-power Elwell-Parker accumulators, which are charged in the morning, so as to afford a reserve in the event of a break down.

Domestic Electric Lighting and Heating.—Mr. E. H. Johnson, president of the Edison Electric Lighting Company, U.S.A., has his private residence lighted with incandescent lamps. The dynamo is in the cellar, and is said to make so little noise that it cannot be heard on the floor above. A small engine supplies the dynamo, and the exhaust steam is used in heating the house. Mr. Johnson's experiments have proved satisfactory, and he promises to make connection with one or two of his neighbour's houses for the purpose of furnishing them with light.

Electric Light in the Mersey Tunnel.—On Friday last week, the completion of the Mersey Tunnel was celebrated by a meeting of the Mayors of Liverpool and Birkenhead at that part of the tunnel which is directly underneath the middle of the river, the boundary of the two counties. Oratory followed, the decorations, trophies and dais being illuminated by the electric light.

Electric Light Patents in America.—The New York *Electrician and Electrical Engineer* states that the United States Electric Light Company has instituted a suit against the Thomson-Houston Electric Light Company, of Connecticut, having its factory at Lynn, Mass.; the American Electric Illuminating Company, and the Merchants' Electric Light and Power Company, of Boston, for the alleged infringement of an important patent connected with the electric light. The New England Weston Electric Light Company is a party in the suits against the two last named companies. A permanent injunction is asked for. The infringement alleged is on E. Weston's patent—234,443, November 16th, 1880—on a ventilated armature for dynamo machines. The Thomson-Houston company defends the suits.

Electric Lighting for Printing Offices.—For the last fortnight the offices of the *Bradford Observer* have been illuminated at night by the electric light. At the close of last year the proprietors of the *Observer* entered into a contract with Mr. Wilson Hartnell, of Leeds, to light up the major portion of their premises. The installation consists of 76 Swan 20-candle lamps, which are suspended from light wooden framework over the positions occupied by the men in the composing-room, and, in the case of the commercial department and the editor's and reporters' rooms, from the ceiling. The motive power is an Otto gas engine, the dynamo a Crompton-Bürgin. A small solid steel flywheel is fitted to the shaft of the dynamo, and this has a marked effect in overcoming the slight, though inevitable, variations in the speed of the gas engine.

The Thomson-Houston Light.—The New Haven Electric Light Company (Thomson-Houston) is paying a dividend of 16 per cent.

The new company just started in Norwich, U.S.A., is to put in a 100-light Thomson-Houston plant. A success is predicted.

The new plant just put in at Achison, Kansas, has been so successful and satisfactory, that the local company, in order to comply with the demand, has duplicated its order with the Thomson-Houston Electric Company.

The Citizens' Electric Light Company of Akron, Ohio, has now nearly 200 lights running on the same system.

The Edison Lights in America.—From the annual report of the Edison Company for Isolated Lighting (New York), we learn that during the year ending November 1st, 1884, 143 isolated plants, aggregating 19,390 lights, have been installed, making a total, since the formation of the company, of 417 plants for 75,145 lights. The report says:—"During the past year your company has met with active competition from numerous infringers on the Edison patents, who, encouraged by the inaction of the Light Company, have become more and more emboldened, until many of them now exist as organised companies, working in opposition to your own. Your board is happy to say that the Light Company is now taking active steps to protect its patents in the courts, and there seems to be every reason to hope that speedy and favourable decisions will be secured, thus justifying your claim to the possession of the only practical system of incandescent lighting." The balance sheet shows that the net profits on business completed during the ten months ending November 1st, 1884, were $60,248.62. The annual report of the Edison Electric Illuminating Company says the enterprise it undertook was one of peculiar boldness. Starting almost from the moment that Mr. Edison had demonstrated the scientific success of his great invention, it undertook to apply practically, and to its fullest extent, a system which had scarcely been tried at all, except in the laboratory, and which, so far as underground and central station work was concerned, existed only theoretically. When the construction of the present central station was commenced there were in use perhaps a half-dozen small, imperfect, isolated plants; and with only these to guide it, the company undertook and has "carried to scientific and financial success the great problem of underground central station lighting by electricity in competition with gas." At the date of the last annual report the first district had scarcely more than reached the point where its receipts were in excess of its expenses. During each and every month of the present year they have shown a handsome increase as compared with last year, and instead of a loss, as in 1883, the operations of 1884 will leave a surplus of fully 3½ per cent. on the capital stock, after paying expenses of every kind. In February and March, 1883, there was a loss of $6,115.84; in the corresponding eight months of 1884 there was a profit of $10,429.46; upon operations in October, November, and December, 1883, $7,207.03 profit; in the corresponding months of 1884, $14,000·00 profit; net loss, 1883, $4,457.50; net profit, 1884, $35,554.40. To neutralise the falling off in profits during the summer months, the company has undertaken to furnish electric motor fans to be run by current from the central station. A heavy item in the operating expenses of the first district has heretofore been that of lamp renewals. Owing to imperfect electrical determinations in the construction of the district, and the consequent inequality of electrical pressure, the lamp breakage was unduly heavy. During the past summer these defects of construction have been mostly corrected, and improvements have also been made in the lamps themselves, with the result of raising the life of lamps from 400 hours of use in January to 914 hours in November, which is equal to a monthly saving of about $400 in operating expenses on the number of lamps in use at the present time. Notwithstanding the recent reduction of the price of gas from $2.25 to $1.75 per 1,000 cubic feet, the first district station has not yet lost a single customer, proof that the light, at its present cost (1⅕ cents per hour of use for lamps of 16-candle power), is found more desirable and satisfactory than gas even at the reduced price. The present district, which is bounded by Wall Street, Broad Street, Exchange Place, Broadway, Spruce Street, and the East River, is stated to be the least remunerative in the city, being occupied mainly by banking and other offices, which are closed on an average earlier than six o'clock, so that the hours of light consumption are very short, and it is proposed to start an "up town" district, to extend from Twenty-Third Street to the Central Park, and from the Eighth to Madison Avenues. It is estimated that during the coming year the "down town" district will earn fully 5 per cent. on its stock, or equal, in other words, to 10 per cent. on the cost at which it could now be duplicated. In an up-town station, where there would be longer hours of light consumption, it is assumed that at least 15 per cent. net profit per annum at the start, could be earned.

Illumination of Lightships.—An interesting experiment, says the Liverpool *Journal of Commerce*, which has already commanded some amount of attention, is being tried in the St. George's Dock, Liverpool, in connection with the illumination of lightships. One of Messrs. R. E. Crompton & Co.'s dynamo machines, with a small engine, has been fixed on board the *Orion* lightship, which is thereby supplied with two powerful electric lights. The experiments are to be continued for a few nights longer, with the consent of the Mersey Dock Board.

The Electric Lighting Act.—At a meeting of the Chelsea Vestry on Wednesday it was resolved to support the application to the Board of Trade for the extension of the time before the option of purchase by local authorities arises, and instead of the 21 years now allowed 35 years was suggested. Mr. Mossop urged that it was impossible to get back principal, interest, and costs in 21 years. If the companies succeeded in so doing it must be hard on the customers, who would have to pay this in 19 years, and all for the benefit of future consumers.

Electric Lighting in the City.—The *Pall Mall Gazette* says:—"The agreement between the City Corporation and the Hammond Electric Light Company has been finally completed and signed, and the Hammond Company has deposited the stipulated £5,000." Commenting upon this statement the *Financial News* remarks:—"Our contemporary is misinformed. The Hammond Company has not deposited £5,000; the amount so deposited comes from Messrs. Alexander, bankers, Lombard Street, in their own name, and with the express understanding that it is to be returned with interest if the contract is not carried out. The £5,000 to be deposited *as forfeit money* is not yet put up."

Street Lighting in New York.—There are nearly 35 miles of streets lighted by electricity in New York.

Telephonic Connection of Coastguard Stations.—On the 9th inst. the Docks and Pilotage Committee of the Aberdeen Harbour Board had before it a letter from the Board of Trade with reference to the Board's contribution towards the expense of maintaining telephonic connection between Aberdeen and the coastguard stations at Cove and Donmouth, reminding the commissioners that the contributions which the Board of Trade guaranteed had now been paid; that whether they would make any further contributions would depend upon circumstances, and have to be considered when the proper time arrives; and requesting that the department might be furnished with a report showing to what extent the telephone had been of service in connection with vessels in distress. The committee resolved to recommend that a reply should be returned to the Board of Trade to the effect that the telephone has been of great service, and expressing the commissioners' hope that the Board of Trade will continue the contribution. The committee gave instructions for the preparation of a report, showing to what extent the telephone has proved of service in connection with vessels in distress. The captain pilot stated that on several occasions the telephone had been found of great service in notifying the fact that vessels in distress were being driven towards Aberdeen. By receiving notice through the telephone regarding ships in danger tugs were got ready and assistance rendered, which resulted in the saving of life and property. Baillie Paterson gave notice of a motion, that the telephone being used for commercial purposes as well as for inquiries as to ships in danger or distress, those who used the wire should pay for the privilege.

Induction on Telephone Lines.—Mr. W. W. Jaques, one of Prof. Bell's coadjutors, has been making investigations upon underground lines, and finds that when the product of the static capacity of the line in microfarads by its resistance in ohms is less than 18,000, it is feasible to use the telephone for commercial purposes, but when this product amounts to between 18,000 and 30,000, then the transmission is imperfect and nothing can be understood except by skilled operators. No telephonic signals can be transmitted when the product exceeds 30,000.

The National Telephone Company.—This company, taking advantage of the recent concessions of the Post Office, has erected a complete system of trunk lines for intercommunication between the different towns in the West Riding of Yorkshire, and the wires formerly rented from the Post Office have been given up.

A Proposed Telephone Exchange.—The National Telephone Company proposes establishing a telephonic exchange in Arlensburgh with communication to Glasgow, provided sufficient support is accorded to this undertaking. The rates for all places of business and private houses within a mile radius of the Post Office, Arlensburgh, will be £10 per annum. For communication to Glasgow the single trunk rate will be £12 10s. per annum, or at the rate of sixpence per conversation of three minutes.

Telephonic Litigation in America.—The American Bell Telephone Company has obtained a favourable decision in its suits against the Overland Telephone Company for infringement of the Bell patents. An injunction in this case was refused some time since by Judge McKennan at Philadelphia, on the ground that the issues involved were much the same as those in controversy in the New York suit of the same complainants against the People's Telephone Company, which ended in favour of the patents. At this trial additional testimony was put in by the defence, tending to show that a pair of magneto telephones, substantially similar to the apparatus subsequently patented by Bell, had been constructed and used by Alfred G. Holcomb in New York City as early as 1863. It is said that still another competitive telephone company either has been or is about to be formed based on the electro-phonetic telegraph patent of Royal E. House, known as the inventor of the House printing telegraph. This invention was patented in 1868, and the patent is therefore near the expiration of its term. It is doubtful, however, says the *Electrician and Electrical Engineer*, from whose columns we glean the information given above, if the promoters of most of these enterprises have any expectation of being able to maintain their claims before a court.

The Telephone on the Congo.—The African Association is about to send to the Congo the telephonic apparatus necessary for establishing communications between stations on the lower part of the river.

Expenditure on Atlantic Telegraphy.—The sums paid for Transatlantic telegraphy during the past year amounted in the aggregate to £888,000, whilst for the preceding year the amount was £939,000, the rate being the same, and the reduction being due to depressed trade.

Telegraphic Facilities. — The chairman of the Greenock Chamber of Commerce announced at the last meeting that negotiations were proceeding with a view of getting a direct wire from Greenock to Liverpool.

Sixpenny Telegrams.—To meet the expected increase of work when the sixpenny telegram tariff comes into operation, 3,000 additional operators are being trained throughout the country.

Telegraphic Money Orders.—It is said that the Postmaster-General has under consideration the introduction of a telegraphic money order system.

Telegraph Revenue.—The receipts upon the telegraph service from April 1st, 1884, to February 14th, 1885, amounted to £1,550,000 against £1,545,000 received from April 1st, 1883, to February 16th, 1884.

The Telegraph and the Soudan Campaign.—For the field telegraph additional wire and poles are being prepared at Woolwich, and the manufacture of reels and barrows for carrying the wire has become a special industry in the Royal Carriage Department. The wire is very light, galvanised, and the poles are mere rods, 12 feet high.

African Cables.—The money article of the *Daily Telegraph* last Saturday contained the following:— "We have received some communications pointing out the great inconvenience caused by the interruption of the South African Company's cable, and urging that some steps should be promptly taken either for the duplication of the line or for the opening of an alternative route on the West Coast of Africa. It is exactly a fortnight since the Zanzibar-Mozambique section of the cable was broken, and the fault has not yet been repaired, although no time was lost by the Eastern Telegraph Company in adopting the necessary measures. Considerable loss of time frequently happens in such cases, for repairing ships cannot be everywhere at once, and however perfect may be the apparatus for grappling with a cable and raising it, the local conditions do not always allow the work to be attempted. A second line is therefore indispensable, and on every other portion of the Eastern Company's system and of the lines affiliated to it duplication has already been carried out, with an amount of benefit to the public and to the company's finances which it is not easy to estimate. The African cable will have to be doubled as a matter of course, and our principal reason for calling attention to the point is because we think it important that the advantages of the West Coast should not be overlooked. A few years ago Sir Donald Currie pressed for the selection of that route, but its claims to notice have immeasurably increased since, even, indeed, during the last few months the Congo and Niger questions and the competition for territory along the entire length of the Continent having assumed a prominence which no one would have anticipated three years ago. It so happens that the Eastern Telegraph Company and its allies have peculiar facilities for establishing telegraphic communication down the West Coast of Africa, since the present station at the Cape Verde Islands gives a starting point from which they could reach the Continent either at Senegal or Sierra Leone, and thence proceed southwards by Cape Palmas, the Bight of Benin, the delta of the Niger, the Congo, Benguela, and Walfisch Bay to Cape Town. So many European Powers are now interested in these regions that valuable subsidies could doubtless be obtained for any well-considered scheme of submarine telegraph communication, Portugal, France, Germany, and Belgium, to say nothing of England, would contribute readily enough if assured of the effective establishment of such a system. There is no organisation so well qualified as that of the Eastern Telegraph Company for this work, and probably the directors only require to make an effort to be assured of success. But no time should be lost in taking the initial steps, for the field will most certainly be occupied soon by energetic rivals, French or German, unless English enterprise forestalls them.

Cable Repair.—The Direct United States Cable Company's main cable having been repaired, communication with the United States of America and Canada, West Indies, and Central and South America, "*via* Direct Cable," is re-established.

The Mackay-Bennett Cables.—The *Faraday* successfully laid the shore end of the Havre section of the Mackay-Bennett cable on Tuesday evening last week and spliced it to the underground cable.

Mr. Cyrus Field.—It will be remembered that at the recent meeting of the Anglo-American Telegraph Company it was urged in antagonism to Mr. Cyrus W. Field that he was connected with the Wabash scheme. Concerning this matter, his solicitors in London, Messrs. Bircham & Co., have written as follows:—"With reference to statements made in some of the London papers to the effect that Mr. Cyrus W. Field was concerned in the payment of sham dividends on Wabash Preference Stock and in placing that stock in London, we are desired by Mr. Field to say that these statements are wholly untrue. Mr. Field ceased to have any connection with the company in March, 1880, when he sold all his stock in the open market in New York, and has never since held any interest therein. The first dividend was paid in February, 1881, when Mr. Field was in India. He was in no way concerned in placing the stock in London, which occurred long after he left the company."

Electro-Motors on the New York Elevated Railroads.—Referring to Mr. Magnus Volk's application for the inclusion of his inventions in the proposed amalgamation in regard to the scheme for using electro-motors on the New York elevated railroad system, the *Electrical World* (N. Y.) does not see "just what good he expects to derive from entering the great 'association of inventors and owners'"

Another Atlantic Cable.—Referring to our report of the recent meeting of the Anglo-American Telegraph Company, and the interesting discussion which then took place concerning competition, not only in the rates charged after cables have been laid, but also in the prices charged for the cables themselves, the following extract from a Portuguese paper of standing (*O Egonomista*) will give material for serious reflection, as it indicates a proposed increase in the number of cables across the Atlantic, notwithstanding the strong and disinterested opinions which have recently been expressed in meetings of a somewhat similar nature to that referred to above. The question arises, whether the temporary and simultaneous silence of even four Atlantic cables justifies the laying of another one. It seems that with the competition so keen as it at present is, any addition to the number of cables would be a mistake; but the names of the companies mentioned in the following extract are a warranty that nothing will be undertaken rashly:—The Brazilian Submarine Telegraph Company sends to its shareholders a circular intended to show the attitude of that company on the question of the submarine telegraph lines projected for the Azores and the Western Coast of Africa. It gives them to understand in substance the propositions which they, in accord with the Eastern Telegraph Company, and the Telegraph Construction and Maintenance Company, have sent in to the Government for the establishment of these two lines. The propositions addressed to His Excellency the Minister, Secretary of State for Public Works, Commerce and Industry, comprehend the establishment within a period of six months, without any subsidy or guarantee of revenue, of a submarine telegraph cable between the Island of Madeira and those of San Miguel and Fayal, and the execution in stated periods of time of extensions; on one hand to North America, either by Newfoundland, St. Pedro Miquelon, or Nova Scotia, or by the Bermudas; and on the other hand to the West Indies and Panama.

Large Gandy Belts.—We understand that at the Exhibition at New Orleans the main driving of over two miles of shafting is accomplished with four cotton belts, the largest being 60 in. wide, made by the Gandy Belting Company.

Common Sense in Electric Lighting.—A correspondent has sent us the following, which, however, arrived too late for our Correspondence columns:—My reason for writing to you on the above subject is in consequence of seeing there is at present a tendency to cry down arc lamps, and to use incandescent lamps under circumstances for which, I may say, they are quite unfitted. Some time ago a great authority (and deservedly so) in electrical matters stated that arc lamps were unsuitable for indoor use in consequence of their being so unsteady. That theory is of course by this time completely exploded. Now the same authority, I see by your ELECTRICAL REVIEW of Feb. 14th, stated in the land of arc lamps, before the National Conference of Electricians, Philadelphia, that their days are numbered, and gives as a reason that improvements have been and will be made in incandescents. If progress or improvements are being made with incandescent lamps, surely from this we are not bound to infer that improvements are not possible with the arc? I look on arc and incandescent lamps as respectively the boys and girls of one family. One branch of the family is just as likely to go on improving as the other. I shall state a fact ("not a paradox") that I will undertake to show Mr. Preece arc lamps driven by a Marshall steam engine, using Siemens cored carbons for positive, and Johnson and Phillips solid carbons for negative, which will invariably equal any incandescent lamp for steadiness, with the result of ten times the amount of light that could be produced by the same expenditure of power in using the incandescent. Now as to attention required. Provided you supply the engine with the necessary pressure of steam to do the work wanted of it, and have your lubricators sufficiently large, you can leave the engine to take care of itself for any number of hours, without any anxiety, and the same applies to the dynamos and lamps. It is a waste of words to say that arc lamps are unsuitable for private dwellings; this is understood by the merest novice, but when I am told that for a recent contract to light a number of the streets in the City, incandescent lamps are to be used, all I can say is, if such an idea be put in practice the interests of electric lighting will have another blow from which they will take years to recover.

Gas is quite good enough for street lighting if you don't want a larger amount of light than gas gives, as there is always an abundance of the oxygen of the air for the gas to consume between the top of the lamp-post and the moon. I contend the richest city of the world (doing the largest amount of business of any within a given area) in these days of dynamite scares ought to have the principal business streets lighted like daylight, and that the extra security afforded would be worth the increased expenditure. To use incandescent lamps for such a purpose would be a perfect farce, and as a result would end in a fiasco, for the simple reason that the use of incandescent lamps, all things considered, do not show any advantages over gas for street lighting where an illuminating power of 20 to 60 candle power is considered sufficient. The commercial and legislative difficulties of electric lighting are quite enough without adding to them, and the foolery of trying to light up streets and large lofty railway stations with incandescent lamps ought to be protested against. At least, let us have the subject ventilated in your influential journal, so as to have a general expression of opinion in the all round interests of electric lighting.—A. L. F.

Holders for Incandescence Lamps.—We would call special attention to the description of a new holder—the "Vitrite"—for lamps which we publish this week. It appears to us to about the best thing of the kind we have yet had brought to our notice, and there should be a great field for its employment.

The Underground Wire Law in Brooklyn.—In his annual message, a week or so ago, Mayor Low, of Brooklyn, said:—"The underground telegraph law, so called, of last session has been a great embarrassment to the city. Its only known effects thus far, excepting a slight experiment with underground wires by the telephone company in the neighbourhood of the City Hall, have been to prevent the city from securing $5,000 worth of telephone service per annum free of cost, and to prevent, in a number of instances, the extension of the fire alarm telegraph system. The effect of the law is wholly negative. It does not provide a single positive direction or method as to the accomplishment of the end which it enjoins. I am clearly of the opinion that Brooklyn ought to be exempted from its provisions, unless at the ensuing session of the Legislature it can be made a practicable measure."

The Soudan Campaign.—The *Calabria*, belonging to the Telegraph Construction Company, has been taken up by the Government for three months certain, and has a staff of engineers busily engaged in fitting her up. She has eight condensers, worked by three Tangye steam pumps, in addition to her own power, and each condenser is capable of condensing 7,000 gallons daily. She has also four tanks holding 1,100 tons of water, and other tanks are being fitted in addition. Upon her arrival at Suakim she will have a stock of nearly 2,000 tons of fresh water on board. She will also be used there as the headquarter ship. She is taking out several miles of cable to connect her with the shore, and three complete sets of telegraph and telephone instruments.

Electrical Tramcar at Battersea.—We learn that an engineer from Messrs. Siemens Brothers is advising the Wandsworth Board of Works in the inspection of an electrical tramcar proposed to be used on the lines at Battersea.

Transfer of Business.—The business hitherto carried on by Mr. F. Roberts, at Telpher House, 73, Great Eastern Street, E.C., in the manufacture and sale of the measuring instruments, electro-motors, &c., invented by Profs. Ayrton and Perry, has, by arrangement with the inventors, been transferred to Messrs. Latimer Clark, Muirhead & Co., Limited.

The Society of Telegraph Engineers and Electricians.—At the next meeting, to be held at the Institution of Civil Engineers, 25, Great George Street, S.W., there will be a discussion on Mr. Illius A. Timmis's paper on "The Working of Railway Signals and Points by Electro-Magnets, &c.;" and a paper by Sir David Salomons, Bart., on "Constant Electromotive Force in an Electric Light Circuit" will be read.

Strange Death by Lightning.—On Friday week the deputy-coroner for East Middlesex held an inquest on the body of a Mr. Brown. On Saturday deceased took his wife for a walk, and they had just returned when a violent noise startled them. Brown went to the door, exclaiming, "It's an explosion." He added, "I am struck in the eye," and staggered against the door. There is no doubt that Mr. Brown died from an electric shock; he never recovered consciousness, but lingered for 48 hours. Is there another instance on record, remarks the *Standard*, of a man noticing the thunder, even making a remark about it, before the lightning strikes, or before he is conscious of the blow? It would appear from the post-mortem examination that the brain was congested, and a clot of blood was found at the base of the optic nerves.

The Telegraph Corps.—On Saturday last, at Aldershot, the Duke of Cambridge inspected the Army Telegraph Corps. On Monday morning the detachment of the Air Line Section of Telegraph Troops, R.E., left Aldershot for the Albert Docks, and embarked for Suakim. They were loudly cheered by civilians and soldiers along the route.

Electrical Measurement of Water Levels.—The Water-Works Committee of Bradford Corporation has decided to connect, by telephone, four of its most important outlying reservoirs with the engineer's office at the Town Hall, so that the quantity of water in each reservoir may be readily ascertained at headquarters. During the severe drought of last season, when the burgh was on the verge of a water famine, much inconvenience arose from the difficulty in obtaining such information. Tenders were given by the Post Office and the National Telephone Company for carrying out the work, which involves the erection of some thirty miles of wire. The Telephone Company has obtained the contract.

An Electric Launch for Patrol Purposes.—An experimental trip was made with a newly-fitted electric launch on Tuesday evening from Millwall to London Bridge and back, and on Thursday evening a further trip was made from Westminster Bridge, with the intention of demonstrating the superiority of electrically-propelled boats to any other for the purpose of patrolling rivers and harbours. One of the novelties on this launch is a search light of 3,000-candle power, which is actuated by a set of E.P.S. accumulators, which also propel the launch by means of a Reckenzaun motor, at a speed of 8 miles an hour. The search light is sufficiently powerful to illuminate the whole width of the river at will.

The Lundy Island Cable.—We understand that the Lundy Island cable which has been interrupted for some weeks is now being repaired. Stress of weather has hitherto prevented this being accomplished.

Overhead Wires at Wandsworth.—At a recent meeting of the Wandsworth District Board of Works, a recommendation of the General Purposes Committee, that the London Brighton and South Coast Railway Company be called upon to remove certain telegraph wires erected over the Streatham High Road, was adopted.

Gambling in the Civil Service.—The Postmaster General has issued an official instruction upon this subject, in which he says:—"A case having recently occurred in which betting on horses and playing with cards, for stakes far beyond what the players could afford to lose, were proved to have taken place, not only on the official premises, but in some instances during the official hours, the Postmaster-General has felt constrained to direct that the superior officer who had taken part in and encouraged these malpractices should be dismissed, and that of six subordinates one should be required to resign, and five be reduced in their class—the reduction ranging from four to 44 steps. A postman, also, who acted as housekeeper, has been deprived of the housekeepership, as well as his good-conduct stripe. The Postmaster-General deems it his duty to make these punishments known by way of warning, as in the case of Post Office servants he regards gambling in any form as a most serious offence, and one which it is incumbent on him to put down in an exemplary manner." The Postmaster-General also re-issues a notice concerning betting which appeared in the Post Office circular of August 26th, 1878, as follows:—"Any servant of the department who shall hereafter be concerned in betting will render himself liable to dismissal."

House to House Electric Lighting.—The Consolidated Electric Company has issued a circular calling attention to the Colchester experiment to which we have referred in our other columns. Extracts from the ELECTRICAL REVIEW, the *Standard* and *Daily Chronicle*, together with some four or five testimonials from residents in Colchester, make up its contents. We learn, also, that from the time the B. T. K. system was inaugurated—on the 11th of June, 1884—the lighting has continued without interruption. We unfortunately received this intimation too late to do more than notify the fact, but we shall probably learn more respecting the Colchester lighting during the next week or so.

The Bell Company in Canada.—Notwithstanding the adverse decision reported in our last issue, we hear that the Bell Telephone Company of Canada has not by any means given up the fight for the exclusive rights in Canada to which it claims to be entitled under the Edison, Phelps, Blake and Andrews patents. Proceedings have now been taken in the Court of Chancery against the Toronto Companies.

Cutting Telephone Wires.—All the telephone wires on Staten Island were cut one night recently. A few days previously the salaries of the *employés* of the company were all largely reduced, when the superintendent and other *employés* resigned. The perpetrators of the mischief are unknown. The cutting was done in several places and the ends of the wires tied together.

Telephony in the Dundee District.—The list of the subscribers to the Dundee district exchange, in the smart attire usual with these publications of the National Telephone Company, has reached us. There is no continuously numerical list of subscribers, but from a rough calculation of the contents of the book there appears to be between 600 and 700 connections with the exchange. The names are given of half-a-dozen subscribers to an exchange at Forfar. Mr. J. D. Miller, who, it will be remembered, was recently at Aberdeen, has now assumed the managerial duties at Dundee.

The Distribution of Electricity.—The third and concluding Cantor lecture by Prof. George Forbes was given on Monday evening last before the Society of Arts. We have reported these very fully, and we feel sure that electricians generally will appreciate much that is contained therein.

Electric Lighting in Tin Works.—The Pontypool Iron and Tinplate Company is lighting its tinworks by means of a combined installation of arc and incandescent lamps on the Gülcher system, the current being taken from a No. 4 Gülcher low-tension dynamo. The lamps are arranged as follows:—Four 2,000-C.P. factory lamps in No. 1 mill; two 2,000-C.P. factory lamps in new mill; three 2,000-C.P. factory lamps in trimming house; thirteen incandescent lamps in sorting room, two in engine room, two in boiler house, three in office, and three in smith's shop.

The Joule Club.—Manchester, says the *Mechanical World*, has been celebrated for a century past for its clubs, many of which have been of an unusual character. Among others more interesting to ourselves is a small club formed by a group of gentlemen following scientific pursuits, who have dubbed themselves—without permission—the Joule Club. The number of members is absolutely limited to fifty, and it is an understood rule that no member is to endeavour to induce his friends or others to join. At their meeting they first join in a social tea, the cost of which is limited to a small amount; this safely and comfortably disposed of, the evening is occupied with informal discussion of suitable subjects, or a short paper is read equally informally. In the summer, works and objects of interest are visited. This club held their second annual meeting a few evenings ago, when it was found that the treasurer had the amount of nearly the total subscriptions of the members for a year in hand, with a similar amount due. Liabilities *nil*. As the name of the club implies, the members have a preference for physical science, but the discussion of other scientific or related subjects is never discouraged.

NEW COMPANY REGISTERED.

Electric Manufacturing Company, Limited.—Capital £3,000, in £1 shares. Objects:—To take over the business of electrical engineers carried on by the firm of Messrs. Benton and Grubbe. Signatories (with one share each)—H. N. Myers (electrical contractor), 4, Great Winchester Street; H. H. Grubbe, (electrical engineer), 29, Holland Park; F. C. Phillips (electrical engineer), 2, Victoria Mansions; C. H. Benton, (electrical engineer), 2, Victoria Mansions; H. P. Allender, 4, Great Winchester Street; G. Davis, 80, Coleman Street; C. W. Jones, 124, Cassland Road, South Hackney. Registered 18th inst., without articles of association, by G. Davis, Son and Co., 80, Coleman Street.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Pilsen-Joel and General Electric Light Company, Limited.—An order of the Chancery Division of the High Court of Justice, dated 24th ult., authorising the reduction of this company to £84,400, divided into 100 shares of £4 each and 28,000 shares of £3 each, was duly filed on 13th inst. The £4 shares are deemed fully paid, and £3 shares are deemed to have £2 5s. per share paid up thereon.

Change of Office.—The office of the New Telephone Company, Limited, is now situate at 4, Great Winchester Street, E.C.

CITY NOTES, REPORTS, MEETINGS, &c.

The Lancashire Maxim-Weston Electric Company, Limited (in Liquidation).

An extraordinary general meeting of this company was held on Thursday, at the Cannon Street Hotel.

Mr. Hugh Watt, upon the motion of Mr. Gray, took the chair, and moved the following resolutions, which refer to compromises recommended by the liquidator in regard to certain actions brought by the company:—"That the sanction of the company be hereby given to the terms of compromise by the liquidators of the company of the two actions now pending in the High Court of Justice, between the company and James Thornton Dadson, and between the said J. T. Dadson and the said company and Hugh Watt, contained in an agreement dated the 21st day of January, 1885, and made between the liquidators of the said company and the said James T. Dadson and the said Hugh Watt, whereby it is in effect provided that the actions shall, on the payment by the said James Thornton Dadson to the liquidators of the sum of £737 10s., be compromised;" and "That the sanction of the company be hereby given to the terms of compromise by the liquidators of the company of the action now pending in the High Court of Justice, between the company and Gustavus Palmer Harding, contained in an agreement dated the 2nd day of December, 1884, and made between the liquidators of the one part and the said G. P. Harding of the other part, whereby it is in effect provided that the said action shall, on the payment by the said G. P. Harding to the liquidators of the sum of £850, be compromised." In moving these resolutions, the Chairman said the company started under the most favourable auspices, having the nucleus of a large business, and it would have occupied a position at the present time second to that of no other company, but for the action of certain large shareholders who failed to pay up on the calls made. He was sorry for the unfortunate position the company was now in, for he was responsible for a very large amount of the capital subscribed. The liquidators had had a very difficult and arduous task, which they had performed in a manner eminently satisfactory, considering the circumstances.

Mr. Swabey and Mr. Whitworth respectively seconded the motions, which were carried unanimously.

The Chairman suggested that at the next meeting it should be resolved to increase the remuneration voted to the liquidators, in consideration of the unexpectedly difficult labours they had had to undertake.

A vote of thanks to the chairman terminated the proceedings.

Maxim-Weston Electric Company, Limited.

The fourth ordinary general meeting of this company was held at the Cannon Street Hotel on Wednesday, under the presidency of Mr. Hugh Watt, the managing director, a large number of shareholders being present. The report, which appeared in the Review of last week, was taken as read, and, the notice convening the meeting having been taken as read,

The Chairman said: It is now about nine months since I had the pleasure of addressing you, and, from the report and balance-sheet placed in your hands, you will have seen the result of the board's work during that period. My prognostications as to dividend, I am happy to say, have proved correct, and while the result may seem small when viewed in corelation with the original capital of the company, and the return we are able to propose is small, I think it is unnecessary to assure you that the results have been brought about by labours the most arduous and continuous, and that chiefly owing to private connections we have been saved from appearing before you to-day with accounts showing a deficit and with little to offer you but hopes that at an early date the tide will turn, and crumbs of comfort based upon equally shadowy and uncertain foundations. I have no intention of reminding you that in no decade during this century has the commercial temperature approached so near to the zero of starvation, or of the fact that few, if any, of the stable industries of our country have shown any return upon capital, as these facts are familiar to every shareholder in the company; and will therefore only add that upon my visiting some of the leading centres of commerce in this country, in the interests of this company, I was shown docks, factories, &c., with only a few men engaged. But for the state of trade the returns we would have been enabled to show would have been more in consonance with my hopes and expectations of a year ago, and more commensurate with the efforts of your directors. Another event which has materially interfered with this company has been the state of chaos in which the affairs of the Lancashire Company was found, and the fact that their indebtedness was much in excess of the statements which induced us to entertain reabsorption, rendering that impossible, and during several months much of my time has been occupied in assisting Messrs. Brown and Whitworth in their arduous task, which, I am glad to say, is now nearly, and, I may add, considering the circumstances, very satisfactorily, completed. As a proof that the policy I proposed to the Lancashire Company, viz., to confine their business to sales, was a correct one, since June of last year 10 installations have been sold in Lancashire, and there are now in Manchester and Liverpool some of the largest private installations of our systems which are to be found in this country. Besides the great depression in trade existing, we have had to centend with the fact that there is an enormous amount of electric machinery in the hands of people with whom cash in hand is, I fear, in inverse ratio to their stocks of plant, and thus we have had to meet purchasers in price, most of whom would accord us an advantage, preferring our systems, and I have in a number of cases thought it desirable to meet them, provided there was a margin of profit, but in some cases where there was to any contractor a clear loss of 30 to 50 per cent., I have allowed my compeers the benefit, feeling satisfied that it was better to bide our time than work for glory and effect the ruin of the company. In the matter of prices, as the American Company decided to abandon Maxim dynamos and lamps, I was enabled to lay in a large stock at very low prices, all of which I have since sold, so that the profits we have made are, to a large extent, due to large reductions in the purchase prices, as well as to the fact that recent improvements in appliances have enabled us to run a much larger number of lamps off the same machines, enabling us to maintain the sale prices in most cases at those of last year, and yet show a large relative reduction to purchasers. You will understand my reasons for not entering into further details. I think you will, from what I have said, fully appreciate the vantage-ground the company now occupy compared with a year or two ago. We have also perfected a small self-regulating machine, specially suitable for a certain branch of lighting, and which we will be able to turn out complete at a price to compare with any honest competitor. There is now only one branch in which the company cannot be said to be in the van of progress; and as we have inquiries for the execution of large orders in this department we are now actively engaged in formulating the data to enable us to alter the proportions of our dynamos so as to compete for and, I hope, secure large orders during the present year. Another advantage we have is that we can now turn out at our works our own brackets, holders, switches, arc lamps, and nearly every accessory. We have recently had to increase our staff materially, so as to finish with promptitude the orders in hand. At present the company have sufficient work in hand to keep us engaged for three months. We are also promised orders upon a number of estimates given as soon as the iron once more has given place to the golden age. The company's staff are entirely practical and mechanical electricians, and we have not one highly-paid electrician, but, at the same time, all the work turned out gives the greatest satisfaction. The expenses of the company are now on the lowest possible scale, and our mechanics and workmen being nearly all engaged by the week, receive no extra pay, although they have had frequently to work till midnight to complete shipping and other orders. In every department economy has been the order of the day, and I have personally superintended nearly every detail connected with the practical at the works, and the commercial and financial at the offices, carrying out everything as if the company were a private enterprise, requiring every care in general arrangements and departmental details, so as to show a margin for the shareholders. I will now refer to the report and balance sheet—but before doing so allow me to thank numerous shareholders for their kind letters, and to assure those who have sent queries that I am at all times pleased to find my co-proprietors showing an interest in the business of the company—and first to deal with the most important part of it, namely, the profit and loss account. You will observe that, as I predicted last year, considerable economy has been effected in working expenses, which have, however, slightly exceeded my estimate, occasioned by the necessity for an increase to our staff. Here we have experienced considerable difficulty, as men conversant with all departments of an electric company's business can hardly be got, and we do not engage any men who cannot wind dynamos, make the brass mountings, &c., repair dynamos and arc lamps in all of their parts, run installations, and fit up any plant. Since the 1st January, 1885, we have had to nearly double our staff, so as to complete within the desired time contracts now in hand, some of which are longer than any we have yet undertaken. As you will see by the balance sheets which have been placed in your hands, the net profits for the nine months from 1st April, 1884, to 1st January, 1885, are £4,975 13s. 2½d., which is nearly equal to a dividend at the rate of 6¼ per cent. per annum. From this sum, however, has to be deducted the deficit at the debit of profit and loss account last year, after crediting the reduction of capital then agreed to, and since sanctioned by the court, which with further sums we have had to pay in connection with contracts entered into by the old board amount to the large sum of £2,544 14s. 7d. The reduction thus caused makes a very great difference in the net balance for the nine months. And now, with regard to the balance sheet, the first item, patents, remains as formerly, although as the company now possess a new self-regulating dynamo of great efficiency, equal, I believe, to anything in the market, and much cheaper than our new Weston, and that the new Weston incandescent lamps last received are better even than those which have now been burning nearly 1,100 hours at Covent Garden with less than 2½ per cent. of breakages, and further, as the recent specifications of new patents contain several valuable and novel inventions, which time will not allow me to refer to individually, I reaffirm what I stated last year, viz., that the new patents acquired by this company during the last twenty or twenty-one months are themselves intrinsically worth the whole amount charged against patents account, independent of all the other patents in the possession of the company, besides those of which we may become possessed, being entitled to all new inventions of the American company up till 1887. All neutral judges agree that we possess the best dynamos, also arc and incandescent lamps known. Looking at the question from another point of view, I think you will agree with me that the company is now in a position to justify us in assuming that in the near future your directors ought to be able to declare dividends not only on a scale which investors in such an enterprise are entitled to expect, but also in view of the fact that a large number of us are holders since the fever period of some years ago, and bought our shares at a rate of premium so that to repay us adequately for interest on our money we should have a return of 10 per cent. per annum. The next item, as you will see, remains very much the same as last year, although all the stock, excepting fixed plant now in hand, is new. The third item, viz., securities, is the same, excepting the shares in the Scotch company, which I succeeded in selling at a price slightly in excess of my last year's valuation. The fourth item, debtors to the company, is a large one—more so than last year, if you include cash due from the Lancashire company, which was dealt with last year among the ordinary trade debts due to the company—owing to the fact that a large portion of this consists of shipping orders and consignments not very long ago despatched, we having found it advantageous to replace stocks sold at once, thus saving a delay of several months in time. This branch of the business the directors have been pushing energetically, as we find it easier to get our list prices abroad than at home, where beggar myself and my neighbour seems unfortunately too much in vogue in this new branch of trade, a policy which has not been disposed of so early as I had hoped in the interests of all the shareholders interested in this industry. You will, I am sure, agree with the directors that the reserve of £800 was a wise step to take, even although it militated against the amount of dividend paid, and although the debtors to the company are of an exceptionally good class, the board having exercised the greatest care so as to prevent bad debts, preferring rather to let orders go past us. Fifth, that of creditors, you will see the claims are small, and at the present moment these, excepting two small American drafts not yet due, have been paid. The balance sheet is prepared, therefore, exactly on the lines of last year. The present board have throughout conducted its business on the cash principle as regards payments, which you can understand has been a somewhat difficult matter in view of the business we have done, one quarter's business alone amounting to nearly double the capital of the company, and the fact that when the present board took office we had second-hand plant worth not not more than £3,000 of market value, and the surplus left from the shares chiefly subscribed for by my friends and myself, after paying the old board's debts, amounted to only about £2,500. Thus, gentlemen, the result of our first year's trading has led to a net profit of nearly 50 per cent. of our capital, and the last nine months of nearly 100 per cent. net profit. It would be egotism on my part were I to deny that this result, during a period of commercial depression, has been the outcome of almost superhuman exertions, and that the board have been admirably supported by their small but efficient staff. To rescue a company from the verge of the irrevocable precipiece of liquidation, sunk in debts, with expenses of about £17,000 a year, against a revenue of about £3,000, with commitments of a ruinous character, the liquidation of which have even during the last nine months cost us an expenditure of about £500, has not been child's play. I think you will agree with me that the pioneers of a new industry have enough to contend with without what I have named; still, I should have felt that I had disgraced the name which I bear, revered as it stands in the domains of science, had I not persevered, even against my own interests, with this enterprise. Gentlemen, it is not my wish to dwell longer on the unfortunate past, nor have I any wish to animadvert on anyone, more especially as there is quite enough in the future to be done in extending and consolidating the business of the company. I will not detain you longer, and I have only to add with regard to dividend that this is necessarily small, as the board had to make up the deficit in profit and loss account last year before making any return to the shareholders. Without detaining you longer, I beg to move the adoption of the report and accounts and payment of the dividend of 5 per cent. for four months, payable as soon as dividend warrants can be printed and sent out.

Mr. Louis Swaby, a director, seconded the motion.

Mr. Gray, while expressing himself highly pleased with the result of the year's working, suggested that it would be a wise plan not to pay a dividend, but to carry forward the whole of the balance in their favour. He moved, as an amendment, that the report and accounts be received and adopted, subject to the withdrawal of the recommendation for the payment of a dividend.

Mr. Bakewell seconded this amendment.

The Chairman stated that he was himself entirely responsible for the recommendation, his colleagues holding the same views as had been enunciated by the proposer and seconder of the amendment. They had honestly earned a dividend, and in consideration of the fact that there were many people connected with the company who could ill afford to lose the money they had invested, he thought it desirable that a small dividend should be paid. Still, if it was the wish of the meeting, he had no desire to press the recommendation. He might say that he had received proxies from shareholders who were unable to attend to the amount of nearly 30,000 shares against the dividend.

One or two other shareholders having expressed their opinion that it would be more to the advantage of the company to carry forward the balance, the amendment was put to the meeting and carried by a large majority.

Mr. Lee moved the re-election of the retiring directors, Messrs. Brown and Watt, which was seconded and unanimously agreed to, as also was the re-election of the auditor, Mr. Henry Dever.

Mr. Gray moved the award of an honorarium of £200 to Messrs. Brown and Swaby, two of the directors who had been most energetic in the business of the company, but had not hitherto received any fees.

This also was unanimously carried, and a singularly harmonious meeting terminated with a vote of thanks to the chairman.

Submarine Telegraph Company, Limited.

THE half-yearly meeting of this company was held at the offices, 2, Throgmorton Avenue, London Wall, on Tuesday, under the presidency of Sir Julian Goldsmid, Bart. The report, which we published in our last issue, having been taken as read,

The Chairman, in moving its adoption, pointed to the fact that the receipts for the past half-year showed a decrease of £682 compared with the corresponding half-year of 1883. This diminution was mainly attributable to the condensation of messages. In the half-year ending December, 1883, 1,396,634 had been transmitted. The number for the June half of 1884 was 1,377,419, and for the December half 1,428,520, which was a larger number than in either of the two former half-years. But, on the other hand, the largest number of words was in the December half of 1883, the number being 17,226,788, as against 16,583,147 in the half-year ending June, 1884, and 17,007,776 in the past half-year. In the December half-year of 1883 the average number of words per message was 12·33; in the June half of 1884, 12·04; and in the December half of 1884, 11·91. The average length of messages, it was found, was less in the winter than in the summer months. Besides the reduction in the receipts, there had been a considerable increase in the expenditure, which included an increase of the salaries of the clerks in France, made in accordance with the terms of the concession with the French Government. There had been a small increase in repairs to cables and premises, and rates and taxes had been higher. He believed that all their cables were now in excellent order. A new cable between Holland and London had been laid by the English Government, and it was a very great advantage to the company. As stated in the report, some expense had been incurred on the company's steamer, £1,600 having been spent on new cylinders and other work. This, however, did not affect the dividend, for provision had been made to meet the expenditure out of a fund set aside for the purpose. The steamer had never been in a better condition than now. On the whole, he might say, so far as he was individually concerned, the condition of the company's affairs was very satisfactory. There was a matter, however, which was not so satisfactory. The French Government had made an application of an entirely novel character. Their relations with the French Government during the many years of the company's concession had been of course regulated by the terms of that concession, and up to last year no such demand had been made upon the company as one which he would now mention. The French Government had applied to them, not only for the payment of clerks at Calais, Boulogne, Dieppe and Havre—the four coast stations where their cables were landed, and where they were connected with the French Government lines—but they also asked them to be good enough to pay what they had never paid before, namely, the clerks at Paris, Bordeaux, Lille, and Rennes, who were employed on the wires directly connected with London. The board felt that they should resist the claim, and had taken the advice of an eminent international lawyer, accustomed to concessions. If the board's resistance of the claim was not successful, it would result in an increased expenditure of £3,618. He might say, in conclusion, that they had done their best to maintain the condition of their property, and on the whole he thought that a dividend at the rate of 14 per cent. per annum, considering the depressed state of trade and the complications in the East, was not to be despised.

Mr. Robert Bourke, M.P., seconded the motion for the adoption of the report, and it was carried unanimously.

The Chairman then moved the declaration of the dividend, which was seconded by the Hon. Ashley Ponsonby, and agreed to, the meeting thereupon terminating with a vote of thanks to the chairman and directors.

The India Rubber, Gutta Percha, and Telegraph Works Company, Limited.

THE directors' report for the year ending December 31st, 1884, says:—

From the annexed accounts it will be seen that the net profit for the past year amounts to £68,968 10s. Adding £37,902 3s. 3d. brought forward, and deducting £15,600 interim dividend paid in July, there remains a disposable balance of £91,270 13s. 3d.

The directors have added £20,000 to the reserve fund, and recommend the distribution of a dividend of £1 per share, amounting to £31,200, and making, with the interim dividend, a total payment for the year of 15 per cent., free of income tax, carrying forward £40,070 13s. 3d.

Both in general sales and in cable work the amount of business has been considerably in excess of that for 1883, apart from the cables manufactured for the Spanish National Submarine Telegraph Company, the laying of which is completed, the subventions from the Spanish and French Governments being regularly paid.

The company's bill in Parliament was passed last year.

The directors, in view of the steadily increasing business of the company, have long felt that great advantages would be secured by having available a considerably larger amount of working capital. In this connection the reserve fund has been of the greatest value to the operations of the company; but now a still wider development of business is opened up, not only by the continued growth of old branches, but also by the new work authorised by the company's Act of Parliament. They have therefore resolved to increase the capital, in accordance with the powers conferred upon them by the special resolutions of the shareholders in June and July, 1864, by the issue of 10,400 shares of £10 each, thus increasing the total issued capital from £312,000 to £416,000. The new shares will be allotted to the shareholders at the price of £15 (being at a premium of £5 per share), in the proportion of one-third of a new share for every old share, or one new share for every three old shares.

BALANCE-SHEET, 31st December, 1884. Dr.—Capital and liabilities—To share capital—amount authorised to be raised, £812,000; to share capital—amount subscribed and paid on authorised issue of 31,200 shares of £10 each, 312,000; to mortgage debentures, £100,000; to reserve fund, 220,000; to loans owing by the company, £118,630 10s.; to sundry open accounts and acceptances, £101,830 2s. 5d.; to amount reserved to cover estimated further expenditure on Cadiz-Canaries-Senegal cables, 6,087 19s. 8d.; to proposed dividend, 10 per cent., £31,200; to amount carried forward to the year 1885, as below, £40,070 13s. 3d. Total, £929,819 5s. 4d. Cr.—Assets and expenditure—By property, consisting of freehold land, buildings and machinery at Silvertown and at Persan-Beaumont; also steamships *Silvertown*, *Dacia*, and *International*, £446,344 8s. 7d.; by debts owing to the company, £129,000 14s. 2d.; by cash with bankers and in hand, £4,284 11s. 2d.; by bills receivable, £7,522 15s. 10d.; by stock-in-trade, including cost of Cape Verd Islands cable, £139,403 18s. 4d.; by debentures and shares in other companies, £130,737 10s.; by cash, stock, &c., at Persan and other agencies, £72,525 7s. 3d. Total, £929,819 5s. 4d.

PROFIT AND LOSS ACCOUNT for the year ending 31st December, 1884. Dr. — To salaries, interest, and general expenses, £58,295 4s. 5d.; to bad debts, £322 19s. 8d.; to income tax, £3,025 3s. 2d.; to depreciation written off buildings and machinery, £14,673 10s.; to directors' remuneration (minimum), £2,000; to balance—profit for the year, carried down, £71,968 10s. Total, £150,285 7s. 3d. Cr.—By gross profit for the year, £139,740 7s. 3d.; by interest received on debentures of the Spanish National Submarine Telegraph Company, Limited, £10,545. Total, £150,285 7s. 3d. Dr.—To interim dividend of 5 per cent., paid 23rd July, £15,600; to proposed dividend of 10 per cent, £31,200—£46,800; to amount added to reserve, £20,000; to balance to be carried forward to 1885, £40,070 13s. 3d. Total, £106,870 13s. 3d. Cr.—By balance brought down, £71,968 10s.; *less* additional remuneration due to the directors after payment of 10 per cent. to shareholders, £3,000—£68,968 10s.; by amount remaining from the year 1883, brought forward, £37,902 3s. 3d. Total, £106,870 13s. 3d.

South Eastern (Brush) Electric Light and Power Company, Limited.

MESSRS. W. HEWETT, Junr., and R. Braithwaite have addressed the following communication to the shareholders of this company:—"Having regard to the recommendations of the committee of investigation, it seems to us that in the interests of the shareholders, the sooner this company is wound up the better for all concerned. The letter of the manager referred to in the report of the committee seems to foreshadow an attempt to carry on the company. In order to bring the matter to an issue, and to obviate any possible further delay with its consequent expense, we would ask you to sign and return as soon as possible to Mr. W. Hewett, junr., of 14, Fore Street, E.C., the enclosed requisition. We appeal with the greatest confidence to the shareholders, as we feel sure that it is only by promptly following up the recommendations of the committee, and by stopping the further operations of the company, that any portion of the remaining uncalled capital can be saved.

Union Electric Light and Power Company.—The affairs of the Union Electric Light and Power Company being now fully wound up, the liquidators have given notice that a general meeting of the company will be held at the late registered office of the company, St. Stephen's Chambers, Telegraph Street, E.C., on Monday, 23rd inst., at 2 p.m., when an account will be submitted, showing how the winding-up has been conducted and the company's property disposed of.

Provincial Brush Electric Light and Power Company.—The Court has sanctioned a reduction of the subscribed capital, from £99,205 to £54,526 15s., by reducing by £2 5s. per share the liability upon each of the 19,841 shares of £5 each now on issue. The capital is now £155,357 15s., divided into 20,159 shares of £5 each, at present unallotted, and 19,841 shares of £2 15s. each.

TRAFFIC RECEIPTS.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending February 13th were £3,056, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited

PROCEEDINGS OF SOCIETIES.

The Society of Telegraph Engineers and Electricians.

AN ordinary general meeting of this society was held on Thursday, February 12th, Mr. C. E. SPAGNOLETTI, President, in the chair. The minutes of the last ordinary general meeting having been read and confirmed, and the list of new, and proposed new, members announced, the PRESIDENT stated that he had great regret in mentioning that a telegram had been received announcing the death of Dr. Davy, which recently took place at Malmesbury, Australia. The council having considered it advisable to inquire into the cause of the present depressed condition of the electric lighting industry, had formed a committee, which had decided that the following resolution should be forwarded to the President of the Board of Trade:—

"The Society of Telegraph Engineers and Electricians have seen with regret that, since the passing of the Electric Lighting Act of 1882, public lighting by electricity has not made that advance in this country which was confidently anticipated, and hence there has not been that stimulus to progress in many of the branches of electrical science which might have been expected, judging from the history of submarine telegraphs. That the society having had the matter under careful consideration, have come to the conclusion that the restrictions in the said Electric Lighting Act have in a great measure contributed to check the advance of public lighting by electricity, and they venture to request the President of the Board of Trade to consider whether the said restrictions may not be modified or removed."

A paper was then read by Capt. H. R. SANKEY, R.E., on "Some Experiments in Electrotyping with a Dynamo-Electric Machine, carried out at the Ordnance Survey Office, Southampton." About a year ago the author had been directed by Colonel Stotherd to carry out some experiments on electrotyping, which were completed last December. The process of electrotyping had been in use for 37 years in the Survey Office. From the blocks produced 600 or 700 prints could be obtained, but not more than six or seven were, as a rule, produced at a time. The deposited copper was required to be of such a quality as would allow of engraving being executed on it; for this purpose the metal should be hard. No backing of lead was employed, the deposit being $\frac{1}{16}$th in. thick; duplicates $\frac{1}{8}$th in. thick were also produced. The plates should be uniform, and able to withstand the pressure of printing. Seven square feet of surface were used. The old method of depositing by large Smee cells was found to give very good results, the metal being hard and homogeneous, and of uniform thickness. The cells containing the battery plates (2 feet by 2 feet 6 inches) required constant repair, their durability not exceeding three months. Each depositing bath contained one large and two small depositing plates. The connecting leads consisted of 7-strand No. 16 copper wire. In order to get uniform deposits the plates were arranged horizontally, and were kept continually in motion; the receiving plate was placed lowermost, an arrangement which was necessary, though in some respects disadvantageous. The dissolving plate had to be of very pure metal. In consequence of the rapid deterioration of the Smee cells it was determined to try to employ a dynamo machine; the one selected being that of Elmore. The first experiments caused a granular deposit to be obtained, this resulted in measurements being taken of the current which gave the good deposits in the case of the Smee cells. It was then found that a current of from 23·4 to 26·4 amperes for the 7·8 square feet of surface was being used, this current depositing 1½ lbs. of copper in 24 hours. A current from the dynamo of 30 amperes was then adopted, the dynamo being driven by a six-cylinder Willans engine provided with an electric governor, which answered admirably. The parallel arrangement of the baths did not give successful results, but the series method answered perfectly. By calculation it was estimated that 33 baths, with an output of 120 lbs. of copper per week, could be used. The resistances of the baths were measured by a metre bridge, a current reverser being used; the result showed an average resistance of ·01 ohm per cell, the plates being 7 square feet in area and ¼ in. apart. The opposing electromotive force set up by the cells was found to be ·267 volts per cell, or about 9 for the 33 cells. This was ascertained by Poggendorff's method, two standard Daniell's cells being used; the latter had two porous separators, the space between the two containing a zinc cylinder in sulphate of zinc. An experimental plate deposited in 31 hours with 29·2 amperes of current gave an excellent result, the copper being of a finer grained quality than that obtained from the Smee's cells, this result probably being due to the great constancy of the current. The current density for a 5-square foot plate was 6·1, and for a 4 foot plate 7·6 amperes. With a 2 foot 4 inches by 3 foot 4 inches plate a current of 50 amperes could be used. Deposits were found practical in a vertical bath if air was blown in so as to stir up the solution. On the 10th of December the dynamo was permanently adopted at the office.

The general results of the experiments are shown by the table.

In the discussion which followed the reading of the paper,

The PRESIDENT stated that at the Paris Exhibition some very large plates of pure copper deposited by a Siemens dynamo were exhibited; these plates were remarkable for their size and uniformity.

Mr. CROOKES, junior, said that he had tried to use a dynamo of 150 volts to deposit copper with, but the deposit was very bad; he subsequently caused the current to pass through a resistance of 50 ohms and through a low resistance, and then connected wires from the depositing bath to two points in the low resistance, so that an electromotive force of ·55 volts only was obtained; proper results were then arrived at.

Mr. WILLENN, in referring to steel wire coated with copper, said that a peculiarity of the latter was its softness, so that no annealing was required. The adhesion between the two metals was also very perfect. The difficulty in making such wire was to get the deposit to be quick enough and uniform enough. The use of a few drops of bisulphide of carbon rendered a deposit of copper similar to that obtainable from an alkaline solution.

Mr. R. E. CROMPTON considered that Capt. Sankey had done a great service in reading his paper, as it was most difficult to get information on the subject, and therefore it was difficult to know what kind of dynamos electroplaters really required. He was glad to find that machines giving a comparatively high electromotive force could be used, as the size of the conducting leads would not then require to be great.

Mr. A. J. S. ADAMS inquired if polarisation did not alter the resistance of the baths.

Prof. AYRTON pointed out that the number of watts required to deposit a certain amount of metal depended upon the size of the plates, and no definite rule could be laid down.

Mr. BATES criticised the method which Capt. Sankey had adopted for coupling up the machine as not giving the most economical results.

Mr. GISBERT KAPP thought that the polarisation in the baths

EXPERIMENTS WITH ELMORE DYNAMO.

Armature.—Diameter, 1′ 6½″. Arranged in two sets of 10 coils in series, the two sets being in parallel. Resistance cold, 0·0297 ohm.

Fields.—20 coils arranged in series. Resistance cold, 0·684 ohm. Placed in shunt with circuit.

No. of experiment.	Revolutions per minute.		Steam pressure at engine. lbs. per square inch.	ELECTROMOTIVE FORCE.								Resistance in main leads.	CURRENT.						
	Dynamo.	Engine.		Poggendorff's method.						Deduced from current.	Mean.		Cardew's Ammeter, R = 1,000 ohms. Constant, 18,280.					Deduced from E.M.F. and resistance.	Mean.
				Balancing cells.		Resistances.			Diff. potential terminals of dynamo.				Balancing cells.			Resistance unplugged in box of coils.	Current in main leads.		
				E.M.F.	No.	r_1	r_2	Of leads to dynamo.					E.M.F.	No.	Liquid resistance.				
32	400	130	75	1·07	2	10	Not measured	0·67	...	6·0	...	0·33	1·07	2	10	1,150	18·1	...	...
33	500	170	35	1·07	2	10	42·0	0·67	11·1	11·5	11·3	0·38	1·07	2	10	280	30·4	29·2	29·8
34	300	100	80	1·07	2	10	2·4	0·67	2·7	2·8	2·75	0·34	1·07	2	10	3,680	8·3	7·9	8·1
35	415	140	95	1·07	2	10	23·5	0·67	7·2	7·5	7·35	0·34	1·07	2	10	750	22·2	21·2	21·7
36	540	180	100	1·07	2	10	37·0	0·67	10·0	10·4	10·2	0·36	1·07	2	10	320	29·0	27·8	28·4
37	600	200	100	1·07	2	10	59·0	0·67	14·6	14·8	14·7	0·41	1·07	2	10	70	36·2	35·8	36·0
38	710	230	95	1·07	2	10	100·0	0·67	23·2	22·0	22·6	0·51	1·07	2	10	800	43·2	45·4	44·3

REMARKS.—The engine was worked compound for all experiments, except No. 33, when it was worked simple. An additional resistance of 0·85 was placed in field-magnet circuit.

was an important point to be considered, as it cannot be got rid of.

Mr. Roberts inquired whether the failure of the Ansonia Copper Company, who had manufactured the copper-covered steel wire, was due to the wire proving faulty.

Mr. Preece said that the cause of the failure was simply due to the fact, that he had pointed out that hard drawn copper wire would give results quite as good as the copper-covered steel wire.

Capt. Sankey having replied,

A paper was read by Mr. Illius A. Timmis on "The Working of Railway Signals and Points by Electro-Magnets, and controlling them with a complete block system, efficiently and economically by a current from a primary or secondary battery."

The paper gave full detailed descriptions of the apparatus described in the number of the Review for March 22nd, 1884.

The meeting then adjourned.

Physical Society.—February 14th.

ANNUAL GENERAL MEETING.

Prof. Guthrie, President, in the Chair.

Prof. G. Fuller was elected a member of the society.

The President then read the report of the council, in which the society was congratulated upon the number of original communications read—forty-three during the past year. Among the works undertaken by the society may be mentioned the publication of the first volume of "Joule's Scientific Works," a second volume containing accounts of researches conducted by Mr. Joule in conjunction with other scientific men would be published shortly.

The Treasurer presented a highly satisfactory report.

The Council for the ensuing year was then elected, the result of the election being as follows: *President.*—Prof. F. Guthrie, Ph.D., F.R.S. *Vice-Presidents,* who have filled the office of Presidents.—Dr. J. H. Gladstone, Prof. G. C. Foster, Prof. W. G. Adams, Sir W. Thomson, Prof. R. B. Clifton. *Vice-Presidents.*—Profs. W. E. Ayrton, Shelford Bidwell, Lord Rayleigh, Prof. W. C. Roberts. *Secretaries.*—Prof. A. W. Reinold and Walter Baily. *Treasurer.*—Dr. E. Atkinson. *Demonstrator.*—Prof. F. Guthrie. Other members of council: C. Vernon Boys, C. W. Cooke, Prof. G. Forbes, Prof. F. Fuller, R. T. Glazebrook, Dr. J. Hopkinson, Prof. H. McCleod, Prof. J. Perry, Prof. J. H. Poynting, Prof. S. P. Thompson. *Hon. Member.*—Prof. M. E. Mascart.

The customary votes of thanks to the Committee of the Council of Education, and to the President, Secretaries, and other officers having been passed, the meeting resolved itself into an ordinary meeting of the society.

Miss Marks described "A new line and area divider." This instrument consisted of a hinged rule with a firm joint. The inside edge of each limb is bevelled, and presents a straight edge. One limb is divided on both edges into a number of equal parts, and is fitted by a groove on its outer edge to a plain rule, along which it can slide. To divide a line into a given number of equal parts, the hinged rule is slid along the plain rule till the 12th division from the joint is opposite a fixed mark on the plain rule; it is then placed on the paper so that the 12th division on the graduated straight edge coincides with one end of the given line, and then opened till the straight edge on the inner edge of the other limb passes through the other extremity. The plain rule is then pressed firmly down, and the hinged rule slid along it. As each division of the graduated edge passes the fixed mark, the *e* intersection of the moving edge with the given line is marked, and thus the line is divided into *n* equal parts. The instrument may be used in this way to draw any given number of equidistant parallel lines between two given points. It may be conveniently used in working out indicator diagrams and measuring areas.

Mr. Walter Baily described certain improvements made in his integrating anemometer, which has been previously described. The improvements consist in the substitution of mechanical counters for electrical ones, as it was found in the recent observations with the instrument at Kew that the extra friction of the "contact" was sometimes sufficient to stop the motion. The mechanical counters were found to work satisfactorily in every respect.

Prof. Guthrie showed some specimens exhibiting the similarity of fracture of Canada balsam and glass. The glass had been cracked by heating a metal ring to which it was attached; the Canada balsam had been overheated in a small dish and allowed to cool.

NEW PATENTS—1885.

1569. "Galvanic batteries." W. J. S. Barber-Starkey. Dated February 4.

1583. "Generating, regulating, and applying (for the purpose of electric lighting) electric currents and apparatus therefor." W. P. Thompson. (Communicated by A. G. Waterhouse.) Dated February 5.

1604. "Coating and covering electric wires, and conductors to insulate them." T. J. Pearce, M. W. Beardsley. Dated February 5.

1620. "Telephonic transmitting apparatus." J. L. Corbett. Dated February 5.

1621. "Electric arc lamps. W. J. Mackenzie. Dated February 5.

1639. "Manufacture of covered wire coated with insulating plastic material, and apparatus therefor." J. Taylor, F. Whiteley. Dated February 6.

1676. "Governors for controlling steam engines or other motors driving dynamo machiness. P. W. Willans. Dated February 6. (*Complete*)

1701. "Dynamo-electric machines." M. H. Smith. Dated February 7.

1711. "Laying, carrying, and insulating electric telegraph and telephone wires and electric light and power wires." J. C. Sellars. Dated October 29.

1714. "Electrical measuring instruments. J. R. Pratt. Dated February 7.

1764. "Secondary batteries." J. S. Sellon. Dated February 9.

1784. "Submarine cable grapnels for ascertaining when the grapnel is on the sea bottom." Sir J. Anderson, A. E. Kennelly. Dated February 9.

1785. "Lighting railway carriages by electricity." A. M. Clark. (Communicated by Maschinen Fabrik Esslingen and Electrotechnische Fabrik Cannstatt.) Dated February 9.

1813. "Electrolytic liquids for secondary or storage batteries." H. J. Allison. (Communicated by W. E. Case.) Dated February 10.

1831. "Production of materials to be used in constructing elements for voltaic batteries; apparatus for same." D. G. Fitz-gerald, T. J. Jones. Dated September 25 (12802). (*Complete.*)

1853. "Dynamo-electric machines." T. Nordenfelt. (Communicated by O. F. Jönsson.) Dated February 10.

1854. "Electric arc lamp." T. Nordenfelt. (Communicated by O. F. Jönsson.) Dated February 10.

1855. "Opening electric circuits to prevent damage to the apparatus." T. Nordenfelt. (Communicated by O. F. Jönsson.) Dated February 10.

1856. "Semi-incandescent lamp." T. Nordenfelt. (Communicated by O. F. Jönsson,) Dated February 10.

1857. "Regulating speed of a motor driving dynamo machines." T. Nordenfelt. (Communicated by O. F. Jönsson.) Dated February 10.

1870. "Use of electricity for the automatic stoppage of railway trains." W. R. Lake. (Communicated by R. Snyers) Dated February 10.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1884.

339. "Improvements in telephone transmitters." H. J. Allison. (Communicated from abroad by D. Drawbaugh, of America.) Dated January 2. 8d. In this instrument there is a back-board; a box or case; a front cover having a mouth orifice; a rear cover, also having a central orifice; a front diaphragm and a rear diaphragm; blocks of wood or other material support the instrument at a distance from the back-board. By this construction, sound waves impinge upon the front diaphragm directly, and upon the rear diaphragm after a whole or partial reflection from the back-board thus vibrating both diaphragms, relatively in opposite directions, simultaneously. The electrodes are arranged between the two diaphragms, one electrode being fixed to the rear diaphragm, and having an inclined upper surface, and the other one resting upon said inclined surface by gravity, and receiving motion from the front diaphragm. To the rear diaphragm and at about its centre is secured a block of wood or other suitable material upon which is attached by a screw or in any convenient way, a metal plate. This plate is covered or coated with an electrode compound, which is prepared in the following way: the inventor pulverises gas carbon finely and mixes it with what is known as rubber varnish, that is to say, pure rubber dissolved in bisulphide of carbon, so as form a pasty mass. A metal plate is partially or wholly covered with the electrode compound. Another metal plate is also covered with the electrode compound used substantially the same way. To the back of this plate is secured a projecting piece also of metal, having a curved outer edge. On the front diaphragm is secured two pieces of wood, with a space between them, into which space enters the curved edge of the projecting piece. These pieces prevent lateral displacement of the upper electrode which rests upon the lower electrode by gravity.

1280. "Improvements in apparatus for opening and closing electric circuits." F. H. Varley, W. Beale, R. H. Padbury and J. R. Shearer. Dated January 11. 2d. Consists of an electrical commutator or circuit opener or closer placed in air tight case for the purpose of preserving the contacts and the working parts from dust, &c. The contacts and moving parts are actuated by and through the employment of a plunger stem or rod, which in their normal position either keeps open or close the electric circuit according to special requirements.

2428. "Improvements in electric bells and motors." J. C. Bayley. Dated January 31. 6d. Relates to a method of obtaining continuous rotary motion from a vibrating armature.

11894. "Improvements in the insulation of electric conductors, especially applicable to the manufacture of compound conductors for telephonic and other purposes." A. W. L. REDDIE. (Communicated from abroad by E. D. McCracken, of America). Dated September 2. 6d. This invention is based on the discovery that thin manilla, or other pure vegetable paper, possesses in a high degree the qualities for an insulating material, and that by its use it is possible to obtain a more nearly perfect insulation with a less thickness of covering than has heretofore been possible. The improvements consist in an electric wire having a covering consisting of a spirally wound and lapping strip or strips of paper, composed of pure vegetable fibre and applied in its unchanged fibrous condition to the wire, the paper forming of itself, the insulating covering for the wire. The improvements also consist in an electric wire having a covering consisting of a spirally wound and lapping strip or strips of paper, applied with a waterproof adhesive substance consisting of a thin solution of India rubber, the paper forming of itself, the insulating covering for the wire.

12895. "Electric railway signals." W. VOGEL. Dated Sept. 27. 8d. Consists in—First: The combination of contacts placed along the road, and connected to batteries at the station, and other contacts connected to a telephone, or other electrically operated device at the station, and used in connection with the batteries, contacts on the locomotive; an electrically operated power mechanism, and a telephone, or other electric device on the locomotive; and the wires which extend from the station and connect with the contacts along the track. Second: The combination of the strong battery, the weak battery, switches, telephone, an alarm bell, with the conducting wires, the two pair of contacts placed along the road, contacts on the locomotive, and the telephone, switch, and alarm bell on the locomotive. Third: In the combination of the electro magnet, armature, train of wheels, and a mechanism for blowing the whistle, all of which will be more fully described hereinafter. The object of the invention is not only to blow the whistle of all of the locomotives which are approaching a misplaced switch, and thus give notice of danger, but to enable telephonic messages to be sent back and forth between two or more locomotives, and between a locomotive and the station.

13242. "Improvements in electric telephonic transmitters." W. B. HALE. Dated October 6. 6d. Consists primarily in causing the vibrations of the diaphragm of a transmitter to act mechanically upon the opposite contacting electrodes through intermediate levers in such manner as to intermittingly press said electrodes against each other with a movement corresponding to the vibrations of the diaphragm but of greater amplitude whereby is effected an extended range of variation of contact between said electrodes and a consequent and corresponding extended range of variation in the current on the circuit in which the said electrodes are included.

14267. "Improvements in or relating to electrically controlled clocks." W. F. GARDNER. Dated October 28. 6d. Relates to a system for automatically controlling clocks and sending time signals, and is an improvement on the system patented by the inventor October 23, 1883, No. 5047.

CORRESPONDENCE.

Telephonic Circuits.

The regions which lie beyond the sound of Bow bells are "terra incognita" to the "Cockney," and it appears that the writer of the leading double-leaded article in the REVIEW of the 14th inst. enjoys a profound ignorance of the existence of electrical engineers and scientists other than those of a certain clique here in Great Britain. According to his statement these latter have of late paid little attention to telephonic matters. I think this is a matter of congratulation, and perhaps the scientific and general public have not lost much by this abstention on the part of such eminent scientists as those who claim a "loose board having two pieces of tin lying on it to be a 'tympan'"—or those who on oath declare that "a cross having its limbs bent so as to form four legs is a circular plate," and others of that ilk.

I venture to say that a very superficial acquaintance with what has been and is being done by electrical engineers and scientists in foreign countries will show that a great deal of attention is being paid by them to telephonic matters—there is the Van Rysselberghe system in Belgium and France, the long-distance telephony in the United States between Boston and New York, and other great improvements.

The ignorance of what has occurred abroad, which is of public notoriety, is, however, surpassed by the ignorance of what occurs under the very nose of the writer of the leader; he writes, "We hear from time to time of threats of litigation between a company and individuals, yet the rumours do not form themselves into tangible shapes." To my personal knowledge that writer did know that an action has been pending for several months between myself and the United Telephone Company, and a notice of that action appears in the REVIEW in which his leader appears.

I shall now make a few comments on several extraordinary statements contained in that "leader."

The writer says, "The main point at issue is that concerning the possibility of producing articulate speech by transmitters working on the make-and-break principle;" and after a few sentences, he writes, "It is not clear, in the first place, why the interruptions should be chosen to take place in the transmitters rather than in the receiver circuit." I leave the writer to explain away, if he can, his contradiction, for does he not say "the main point at issue is in regard to *transmitters* working on the make-and-break principle"—and afterwards he writes, "it is not clear why the interruptions should be chosen to take place in the transmitter rather than in the receiver." I think it is somewhat of a new idea that the receiver has anything to do other than to be actuated by a current regulated and controlled by the transmitter.

The writer says that I "have attempted to prove experimentally that an undulatory current through a closed circuit is not necessary for telephonic transmission," and then adds, "the correctness of his argument must stand or fall by a consideration of what is *technically* meant by a 'closed' circuit. The technical meaning of 'closed' and 'open' circuit working in telegraphy is well understood; by closed circuit we certainly do not mean a circuit which is never under any conditions open at all, nor on the other hand does an open circuit mean one which is never closed."

This very lucid statement recalls to my mind the saying "Bill and Sam are very much alike, especially Bill." What may be *technically* meant by a "closed" circuit in telegraphy has nothing to do with what is positively meant by a "closed" circuit in telephony, which was the subject matter of my report of the experiments I had made. In telephony the "closed" circuit is strictly a "closed" circuit, never intended to be an open circuit at any moment when speech is being transmitted; and the word "undulatory," as used by Bell and Edison, necessarily implies continuity. It is well known that the *continuity* of the current is the one great feature which dominates the patents of Bell and of Edison. That was the chief point at issue in the trials before Lord McLaren and before Mr. Justice Fry. In fact, Bell claims "the method of producing undulations in a continuous voltaic current;" and in Edison's patent the following is to be found: "I find it is not practicable to open and close the line circuit, the circuit to the line must be always closed."

Sir Frederick G. Bramwell, in his evidence before Mr. Justice Fry, said: "In figure 6 you have at the bottom line the undulatory current—where there is an addition to or deduction from the *continuous* current"; and in the Scotch case he said: "in both modifications of Bell's invention there is a *continuous* current of electricity passing along the wires when the mechanism is in operation."

It is superfluous to make any more quotations in support of the established fact that the great principle which Bell and Edison both claim is that of a continuous current in a closed circuit.

Your writer further says: "it would be generally admitted, we think, that a momentary interruption—once, say, in every minute—in a telephonic circuit, would not produce any effect on the articulation." This cannot for a moment be admitted; a momentary interruption would stop articulation during the interruption, and if those interruptions occur one hundred times in a second—equal to 6,000 times in a minute—articulate speech cannot be heard.

Notwithstanding the contention of your writer, it is established beyond question that in a telephonic circuit the word undulatory necessarily implies continuity of current, and the term "closed" necessarily implies a circuit always "closed," and never "open" when the mechanism is in operation.

W. C. Barney.

February 15*th*, 1885.

[Although we anticipated a reply to the leader which appeared in our last issue, we at the same time expected that whatever correspondent undertook to write the same would at least be careful to correctly read what we wrote. To commence with, we did not state that "little attention has of late been paid to telephonic matters," but that "*comparatively* little attention, &c.," a qualification which materially alters the force of the statement, a statement which we hold is strictly correct. As regards our knowledge of telephone matters we are perfectly cognizant of the Van Rysselberghe system and of the long-distance telephony in the United States between Boston and New York, though with regard to the latter it seems rather extreme to claim the erection of a long wire of low resistance as an improvement in telephony. We were also perfectly cognizant of the Barney and United Telephone Company suit, but we deny that such a "storm in a teapot" was anything tangible. Coming now to the "comments on several extraordinary statements contained in that leader," we must point out that we nowhere stated or hinted that the whole of the leader was intended to be a personal attack on recent letters written by Major Barney in our journal, as our correspondent evidently assumes it to be. What we said with reference to the "main point at issue" did not refer to Major Barney's recent letters and it is only the egotism of our correspondent which has made it appear to do so; there is therefore no contradiction to explain away. As regards the paragraph in the letter which says that "it is somewhat of a new idea that the receiver has anything to do other than to be actuated by a current regulated and controlled by the transmitter," we would point out that the primary and secondary circuits in an ordinary telephone apparatus are quite distinct circuits, and the interruptions which may take place in the primary circuit do not cause discontinuity in the secondary circuit, *i.e.*, the circuit in which the Bell instrument is placed. Possibly our "very lucid statement" may remind Major Barney of the saying he refers to, but why it should do so is not clear as there is no apposition betwen the two whatever. If we are to accept our correspondent's arguments, both the Bell and Edison patents can be got over by the simple device of placing a key on every telephone instrument, which key by its depression will open both the primary and secondary circuits, and which the user is to depress for a moment during the time he is conversing through the apparatus; could it be imagined for a moment, however, that such a device would be held by any reasonable being, not to say a court of law, to effect the desired object. The major portion of the latter part of the letter we need not comment on as we have here mere assertions, and assertions are not arguments, although, together with a *tu quoque*, attempts are often made to make them do duty for such. We would add, has not our correspondent used the word "current" in mistake for "circuit" in one or two places in his letter?—EDS. ELEC. REV.]

Intermittent Current in Telephony.

In my letter published in the REVIEW of 14th inst. I described the mechanism I employed to produce makes and breaks in the continuity of the current in order to show that an undulatory current was not necessary for telephonic transmission. The result obtained proved that articulate speech was produced *in spite* of the make-and-break action in the voltaic circuit.

Such an arrangement may not be a practically working one, and would not, in my opinion, be allowed to be used in the United States, and certainly it could not be subject matter for a patent there, because the arrangement for breaking the current would not be considered an improvement, but only a means to avoid the claims of Bell. For the purpose of meeting this difficulty I have continued experiments, and have devised a transmitter by which actual makes and breaks of the continuity of the circuit are produced by the air waves of the voice, and speech is produced with perfect articulation, and this not only *in spite* of but by means of an arrangement specially devised to produce makes and breaks.

In due time, that is so soon as a patent shall have been allowed for it by the United States Patent Office, the system shall be communicated to the public through the medium of the REVIEW.

W. C. Barney.

February 16*th*, 1885.

Telephonic Receivers.

In connection with the reminder in your leading article of this week, that a condenser may be interposed in a receiving circuit, may I ask if the majority of your readers know that the Bell telephone itself may be left out and the condenser used as the receiving instrument, if a dozen or more cells in series are included in the secondary circuit? This arrangement forms the subject matter of a patent taken out by the late Prof. A. Dunand, of Paris, but, as far as I know, it has never been put into use over ordinary line wires, though the articulation is excellent, between the parts of a building. Many of your readers are anxious to upset the telephone monopoly, and in my opinion their best chance lies in the direction of tin foil condenser telephones.

In order to clear the ground for future work, perhaps some of your readers who are well versed in the intricacies of telephone patents will have the kindness to answer the following questions :—

(1). Is a telephone receiver formed of a few sheets of tin foil and paper, arranged as a condenser, an infringement of any patent if used with a transmitter which is clear of patent rights?

(2). Is there any form of magneto transmitter incontestably free to the public?

(3). Is the patent of A. Dunand (who claims the interposition of a battery in the secondary circuit with the condenser) a valid one? If not, whose claims cover it?

(4). Have any of your readers tried a tin foil condenser, as a receiver, over a considerable length of ordinary line wire?

A. S. T. E.

London, *February* 14*th*, 1885.

[We think that our readers are already aware of Dunand's experiments, as we have fully described them and the apparatus employed in former numbers of the REVIEW.—EDS. ELEC. REV.].

Dynamo Winding.

Referring to the equations given by Mr. Moon in your issue of last week for re-winding a series as a shunt dynamo, it may be of interest to point out that the values

$$R_1 = \frac{L^2}{r} \text{ and } r_1 = R\left(\frac{L}{L + r}\right)^2$$

equally satisfy the conditions, or that r may be substituted for R and R for r in Mr. Moon's results.

As in many series dynamos R and r are about equal, this generally does not give much choice in the matter of winding, but it may sometimes be useful.

Thus assuming in a certain case $r = {\cdot}3$ $R = {\cdot}4$ $L = 2$.

Then either $R^1 = 10$ $r^1 = {\cdot}2$ nearly

or $R^1 = 13{\cdot}3$ $r^1 = {\cdot}3$ nearly.

Thus if the armature was known to be able to stand the small increment of current for the shunt, the expense of re-winding the armature might be saved.

In both cases the speed, internal work, and difference of potential at the terminals remain the same, the total E.M.F.'s being in the proportion of $L + r$ to $L + R$.

The proportion of work done in the armature to that done in the field-magnets is, of course, different in the two cases when r and R have not the same value.

The equations given by Mr. Moon produce a machine in which the work done in all parts is identical with that done in the series machine. The alternative values for R^1 and r^1 one in which while the total work is the same, the proportion is varied. The ampère turns on the field-magnets being in the two cases in the proportion of $\sqrt{R}$ to $\sqrt{r}$.

If this alternative winding is given by Mr. Moon in the previous number of ELECTRICAL REVIEW to which he refers, of course it will not be worth while to publish it again.

P. Cardew, Capt. R.E.

Electrical School, S.M.E., Chatham,
16th February, 1885.

Primary Batteries for Electric Lighting.

Can you kindly inform me whether the "Lalande and Chaperon" battery is to be *relied* on for very small electric light installations, and if so how many elements should I require to light five small incandescent lamps, taking 10 volts and about ·8 ampère each, burning them for five hours every night.

Is it a fact that these batteries will run as long as 150 to 200 hours without attention, as I saw mentioned in your "Notes" of February 7th.

If you can give me this information in your next issue I shall feel greatly obliged, and apologising for thus troubling you,

Howard E. Browne.

21, Havelock Road,
West Kensington Park, W.,
February 16th, 1885.

[You cannot reckon upon more than 0·6 volts per cell as a working E.M.F. You would then require 17 cells to produce 10 volts, and as the resistance of your five lamps is only 2·5 ohms when arranged in parallel, the total internal resistance of your battery must be less than 0·1 ohm to give a current strength of about 0·8 ampère per lamp. You will require large cells or a number of smaller ones coupled in parallel. Perhaps some of our readers can suggest the best method for you to adopt. The statement concerning the constancy of the battery is from one who has had great experience in its manipulation.—EDS. ELEC. REV.]

Edison's Patent.

I am somewhat unwilling to further obtrude myself upon your readers in the correspondence now taking place in your columns on telephonic questions, but as no one has replied to the letter of "Das Telephon," which appeared in your issue of 7th inst., I cannot forbear troubling you with a few observations on the subject of that letter.

The point of your correspondent is briefly this, viz., that Edison claimed the combination of a tension regulator with a diaphragm (which we will call A and B); also the combination of a tension regulator, diaphragm, and resonant case (which we will call A. B, and C), that the claim for these three parts (A, B, and C) used in conjunction has been disclaimed, and consequently that any person is at liberty to use parts A and B, provided he also uses part C with them.

Your correspondent's argument is an ingenious one, but it is founded on a fallacy. In the case of an apparatus such as the telephone, if a patentee claims the use in conjunction of two parts, he does not necessarily mean two *only*, hence he does not relinquish his right to add any other parts to them. He simply says: "My invention consists in putting the two parts together, but anything that you add to them in no wise affects my claim to the combination of these two parts, even although I disclaim or do not claim the addition. You may use fifty parts together, but if you use A and B in practically the same way as I do, and as I cover by my claim, you infringe my patent, inasmuch as the two parts which I claim are included in the fifty."

When the invention relates to a chemical composition I grant your correspondent's reasoning may in certain cases have some force, as the addition of a third ingredient to a composition consisting of two ingredients, may essentially modify the character of the product obtained. Even in the case of a chemical composition, however, the conclusion at which your correspondent arrives does not necessarily follow; everything would depend on the nature of the added third ingredient, which might be surplusage in no way affecting the character of the resulting product, but simply used as a blind to cover the infringement. But, I repeat, where the invention has reference to a mechanical combination such as the telephone, his argument is absolutely untenable.

Thos. J. Handford.

42, Southampton Buildings,
February 16th.

The United Telephone Company and its Claims to the Monopoly of Carbon in a Transmitter.

After the persistent claims by the United Telephone Company for years past to the monopoly of carbon in any form in a transmitter, their acknowledgment that they have no right to make such a claim will no doubt surprise your readers. The evidence of such acknowledgment is furnished by the affidavits of their solicitor and retained experts, filed by that company in the action brought by me against that company. In these affidavits they refrain from alleging that the use of carbon pencils in the Boult transmitter, Patent 11363, A.D., 1884, is an infringement of Edison's patent. My action against them has forced them to abandon this absurd claim, and it is possible that the result of the trial—perhaps in November next—will force them to discontinue their threats of prosecution against all persons using a magneto-telephone.

W. C. B.

February 18th.

Dr. Davy.

I have noticed with regret the announcement in your last issue of the death of Dr. Davy in far-off Australia, whose claims as pioneer in the invention of the electric telegraph have been so conclusively proved in the recent work of Mr. J. J. Fahie on the "History of the Electric Telegraph." It is a pity that the wonderful achievements of this early investigator in the domain of science should have remained hidden so long, and the more so that his useful life should come to a close at a moment when honours were being conferred on him. But now that Dr. Davy is gone, would it not be only a matter of courtesy for the Society of Telegraph Engineers and Electricians to in some way recognise Mr. Fahie's efforts and perseverance in unearthing Dr. Davy's inventions, and establishing his title to be classed alongside, if not in advance of, Cooke and Wheatstone?

Observer.

February, 1885.

Lightning Protectors for Telegraph Instruments.

During the severe thunderstorms of last year 22 interruptions of communication by lightning came under my notice. Of the instruments affected four were fitted with twisted wire protectors and the coils of one were fused Eighteen were fitted with tube protectors, and the coils of two were fused. One of the two tube protectors which failed to save the coils was uninjured. My experience of the twisted wire protector is not so extensive as that of Mr. Cooke, of the G. N. Railway, whose letter on this subject was published in your issue of 11th October last; but I have known of several instances in which coils fitted with that form of protector were fused.

I have not, however, known of a single case in which coils were fused where the plate protector was in use.

S.

16th February, 1885.

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